THE

ELECTRICAL REVIEW.

VOL. LXXVII. JULY 23, 1915. No. 1,965.

ELECTRICAL REVIEW.

Vol. LXXVII.] CONTENTS: July 23, 1915. [No. 1,965.

	Page
Science and the War	97
Copper	98
Cathode-Rays in Practice	98
If a Bomb fell on a Generating Station!	98
On Trading with Russia	99
The Central Power Station of the Randfontein Estates, by R. Turnbull Mawdesley (*illus.*) (*continued*)	100
The Tramways and Light Railways Association Congress, 1915	102
Tramways during War Time, by J. W. Dugdale	102
Battery Vehicles as an Adjunct to Tramways, by W. H. L. Watson	103
Correspondence—	
Electric Power in India	104
Shortage of Labour	105
American Trade	105
Legal	106
New Electrical Devices, Fittings and Plant (*illus.*)	108
Business Notes	109
Notes	113
City Notes	116
Stocks and Shares	119
Share List of Electrical Companies	120
Market Quotations	120
Exports and Imports of Electrical Goods during June, 1915	121
The Weaverham and District Electricity Supply (*illus.*)	122
An Investigation of Dielectric Losses with the Cathode-Ray Tube, by John P. Minton (*illus.*) (*concluded*)	124
New Zealand's Water-Power	125
Submarine Photography by aid of Quartz Lamps (*illus.*)	126
War Items	127
Foreign and Colonial Tariffs on Electrical Goods	127
New Patents Applied for, 1915	128
Abstracts of Published Specifications	128
Contractors' Column	Advertisement page xviii

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Trèves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1915 EDITION

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

SCIENCE AND THE WAR.

ON Monday last the composition of the Admiralty Board of Inventions, over which Lord Fisher presides, was published; we note with satisfaction that the list contains the names of Sir J. J. Thomson, Sir C. A. Parsons, Prof. W. G. Bragg, Sir William Crookes, Mr. W. Duddell, Sir Oliver Lodge, Sir Ernest Rutherford, Mr. G. G. Stoney, and Prof. the Hon. R. J. Strutt, as well as other leading men of science—all, with one exception, Fellows of the Royal Society; it is stated also that the Royal Society will co-operate in the work of the Board, and that additions will be made to the Panel of Consultants from time to time, so that the services of specialists who are not already on the list may be utilised for the nation's benefit.

It can hardly be supposed that these eminent men will be called upon to sort out the wheat from the immense bulk of chaff that will be showered upon them by would-be inventors; that would be as wise as to use a steam-hammer to crack nuts. Presumably, therefore, a staff of assistants will be provided, to whom will be entrusted the task of considering suggestions and selecting from them those that appear worthy of the attention of the Board. Upon this staff a great responsibility will rest; it is easy, no doubt, to eliminate such propositions as the electric gun, the aerial torpedo, the magnet to repel torpedoes, and similar chimerical ideas, but there is a risk that in the preliminary sorting pearls of wisdom in rough shells may be rejected, and we trust that none but expert technical men, with alert and open minds, will be employed on this important work.

It was reported on July 9th that Mr. Lloyd George had made arrangements with the War Office and the Admiralty to take over from them the work relating to munitions and inventions connected with the Army, but no announcement has been made as to the formation of a similar Board of Inventions for his Department. It is not clear to us that a separate Board for each department is necessary; surely it would be better to organise a single central body to deal with the whole of the work, as otherwise there is certain to be overlapping in many respects.

Speaking in the House of Lords not long ago, Lord Crewe made the remarkable statement that every effort had been made to utilise scientific knowledge since the beginning of the war; if this is so, it reflects little credit upon those who made the "efforts," for their failure has been conspicuous, while scientific men of all classes, and of the highest standing, have proclaimed their inability to induce the Government to accept their services. At a meeting of the British Science Guild, on July 1st, Sir William Ramsay pointed out that immediately after the outbreak of war the French Academy of Sciences offered all its resources to the Government, and they were at once accepted. In October he had urged the organisation of the Royal, Chemical and Engineering Societies for a similar purpose, but up to the beginning of July no such organisation had been created. Others had made similar suggestions, without success. Sir William complained of the appointment of numerous small committees of men whose names were kept secret, instead of the formation of a central body of scientific men to whom the various departments of the Government should apply for advice and assistance. Despairing of Government action, he proposed that scientific men should organise themselves to combat the attempt of the Germans to obtain world-wide dominion.

Fortunately, we now see the Government, like some weary Titan slowly awakening from his slumber, painfully and sluggishly arousing itself to the realisation that this is not an ordinary war; that we are at death-grips with a powerful enemy, and that we must marshall all our forces, military and naval, scientific and

industrial, to cope with the frightful peril that confronts us. As we have indicated, even now there is a lack of coherence and co-operation in the actions of the different departments of State; they seem to resent the offer of scientific assistance, while they profess to welcome it, and accept it with reluctance. How different is the attitude of the German Government—and what immense advantages it has derived from its free utilisation of scientific effort! But it should be borne in mind that the fault lies not with our Government alone, but with the whole nation, which has for over 60 years contemptuously spurned the aid of science in industry, whilst our foreign rivals have eagerly availed themselves of it, and by this means alone have been able to build up the armaments, resources and organisation which now aim at, and threaten to achieve, nothing less than the destruction of the British Empire.

Copper.

THE less confident feeling which has grown up recently in connection with the copper situation appears to have been well grounded, and the price of standard metal has undergone a steady deteriorating process, until it would require an advance now of about £20 a ton to bring cash warrants into their proper relation with the prices which are asked by producers. How long the ridiculous discrepancy between these two brands of copper, the speculative medium on the one hand, and the favourite grade of consumers' copper on the other, is to last, remains to be seen, but the position which has been gradually worsening for some weeks back has now assumed preposterous proportions. The conclusion is irresistible that the foundations of the copper market have been weakened, and that a substantial decline in prices is in store for refined metal. The production of copper has been enormously stimulated by the high prices ruling, and the high prices themselves have been the outcome partly of manipulation in America, though the manipulation in this case has been less violent than that seen in spelter, while heavy demands for munitions purpose have also been an important contributory factor. There is no doubt that the way in which some of the Allied Governments have been buying munitions in the United States has directly encouraged manipulation on the part of financial and other interests across the Atlantic.

The growing output is now beginning to assert itself. Since the year opened there has been a steady development of output all over the North American continent, and mines and smelters which shut down entirely, or which reduced by 50 per cent. or more, in the autumn of last year, have steadily extended the scale of their operations, until there is no doubt that the United States production of refined copper is to-day well up to the record figures of 65,000 tons a month. Seeing how small, comparatively speaking, the American exports are, owing, of course, to Germany being cut off from the rest of the world, it must be regarded as assured that there is a growing surplus somewhere, though, no doubt, pains will be taken to conceal this until the psychological moment. An idea of what is going on may be gathered from the following. In June the United States exported only 15,000 tons, leaving a matter of 50,000 tons available for home consumption, whereas even in the halcyon days of American trade, the United States never but once returned a monthly delivery exceeding 36,000 tons. There are no definite figures available bearing upon American production or deliveries to the home trade, the publication of the monthly returns by the Copper Producers' Association having ceased at the end of June, 1914, while the Association itself was disbanded at the beginning of the present year.

Consumption generally is proceeding at a very heavy rate, but certainly the last two or three weeks have witnessed very little activity in the direction of new buying. Wherever possible, works are being put on to munitions, but the raw material for their operations appears to have been pretty well provided, and, in any event, the disappearance of Germany as a consumer releases huge quantities of copper, which are thus rendered available for countries whose supplies have not been interfered with. American trade is very active, more especially in the brass connections, but, for all this, the tendency of prices is towards ease. Speculation is dull, and it is just as well that this is the case, for the authorities here are in a mood to take fright at shadows, and any suspicion that speculation was still alive might cause drastic steps to be taken, still further interfering with what trade is left to us. All that average *bonâ fide* traders ask now is to be strictly left alone by the hordes of officials who seem to have nothing better to do than interfere with things regarding which they are sublimely, not to say appallingly, ignorant.

Cathode-Rays in Practice.

WE have often drawn attention to the fact that scientific discoveries which at first are apparently of no more than academic interest, sooner or later find practical applications, and may eventually prove to be of immense value to industry. It would be incorrect to say that cathode-rays have not hitherto passed out of the category of pretty experiments, for they have been turned to account in various ways; but a recent development in which they play the leading *rôle* calls for more than passing comment, and incidentally furnishes an apt illustration of the practical utilisation of a physical phenomenon. We refer to the "cyclograph," which is described in a paper by Mr. J. P. Minton, of which an abstract is concluded in this issue.

The essential characteristic of the cathode-rays to which they owe this application is their instantaneous deflection by an electric field, and their freedom from inertia, which enable them to follow without time-lag the variations in magnitude and direction of the field. These qualities are particularly useful in the investigation of the behaviour of dielectrics under electrical stress, owing to the low power factor and small magnitude of the quantities to be measured, and Mr. Minton, following in the steps of Prof. Ryan, has evolved a practical apparatus for determining the power factor, and hence the energy losses, in dielectrics by means of the cathode-rays. It will be obvious from the description that the manipulation of the apparatus demands the skill and knowledge of an expert, in order that reliable results may be obtained; but so does the oscillograph, in common with many other instruments of the greatest practical value, and, indeed, none but an expert would be expected to pursue an investigation of this nature.

We have been able to quote but few of Mr. Minton's results, of which many are given in the paper; more are promised for publication at a future date. Enough is given, however, to show that the method yields consistent results, and throws light on that very difficult subject of which we know so little quantitatively.

It is interesting to observe that the author emphasises the extremely important influence of moisture upon the behaviour of insulating materials; he goes so far as to suggest that the materials themselves are constant in their qualities, and that the changes observed with pressure and temperature are entirely due to the moisture contained in the capillary spaces of the substance. We are at once reminded of the remarkable series of experiments described by Mr. Sydney Evershed in 1913, in his I.E.E. paper on the "Characteristics of Insulation Resistance," which led him to the same general conclusion. Mr. Evershed's research was exhaustive within its limits, but there is still a vast field open for investigation, and it is evident that the cyclograph will render valuable services in exploring it, as well as in other work for which it is suitable.

Air Raids and Generating Stations.

ALTHOUGH by good luck, or good guidance, those who navigate hostile aircraft have hitherto been unsuccessful in their attempts on generating stations, damage from this mode of attack is not outside the range of possibility. One high-explosive bomb successfully placed might wreck an entire station and do such damage as to prevent the supply of electricity for a very considerable time. Does failure to continue the supply in such circumstances expose a company or local authority supplying electricity to any liability?

It is provided by Clause 30 of the Schedule to the Electric Lighting Clauses Act, 1899, that whenever the undertakers make default in supplying energy in accordance with the terms of the Board of Trade regulations, they shall be liable to such penalties as may be prescribed in the regulations in that behalf.

It has been held, with reference to this clause, that in the ordinary case of company and consumer the consumer's only remedy for failure of supply is to proceed for penalties. He cannot bring suit for damages unless he has a special contract with the company (see Clegg, Parkinson & Co. *v.* Earby Gas Co. (1896) I.Q.B. 592). It may be stated with some assurance, therefore, that undertakers could not be exposed to numerous actions for damages as a result of an aerial raid.

But there is something else. It does not even appear that they would be liable to penalties. The clause above referred to contains the following important proviso :— "Provided that the penalties to be inflicted on the undertakers under this section shall in no case exceed in the aggregate in respect of any defaults not being wilful defaults on the part of the undertakers, the sum of fifty pounds for any one day, and provided also that in no case shall any penalty be inflicted in respect of any default if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply."

Although it is not likely that the Legislature had the possibility of damage from hostile aircraft in mind when they framed this statute, it is obvious that the proviso affords complete protection to the company or local authority supplying electricity. Of course it is needless to say that there is no case directly in point, because, fortunately for us, this kind of war risk has never had to be considered by the Court. The only reported case on the proviso makes it plain, however, that no penalties could attach. Thus in Sun Insurance Co. *v.* Dublin Corporation, which was decided in 1899, a cable laid down proved to be defective, and the supply of energy thus broke down. This was held to be "inevitable accident," so as to excuse those who were supplying electricity from having to pay penalties.

On Trading with Russia.

IN the series of very interesting articles that Mr. John Foster Fraser is writing for the *Standard*, under the title, "In the Land of the Czar," he deals in considerable detail with the question of future trade relations between England and Russia. Article No. 6 (July 16th) is devoted almost entirely to a statement of the views of M. Timiriazeff, President of the Russo-British Chamber of Commerce, as expressed by him in an hour's conversation. The peace-time efforts made by M. Timiriazeff to extend trading operations between the two countries are well known to readers of the ELECTRICAL REVIEW, but it may be of value to the electrical and engineering trade to know the workings of his experienced commercial mind in these days when Russia is engaged in deadly struggle with the nation which has supplied her with so many manufactures in the past. M. Timiriazeff expresses the hope that England, with the other Allies, will derive commercial benefit from the war, but he considers that "Tariff advantages would be an impossibility; it would be continuing the war against Germany in another field and would lead to much uncomfortableness. Germany will be allowed to come into our markets on an equality with other nations, and will undoubtedly put forth tremendous efforts to regain her lost position." The antagonism will take years to subside, rendering possible a renewal of the "easy relationship between Russians and Germans" which existed before the war. Russia will be more inclined to trade with her friends: "We want English goods; we prefer them; and it is with your manufacturers to decide whether we shall have them." M. Timiriazeff is strongly of opinion that when a treaty of peace comes to be signed there will be inserted a provision prohibiting Germany from imposing differential tariffs. He is very anxious that when peace is signed Germany shall be "deprived of the power to enforce new commercial conventions, to run for 10 years, and to be abrogated on a year's notice, causing much worry to our trading community." "We can have no tariff directed specially against Germany." It is wrong, in this expert's opinion, for us to imagine that England's comparative failure has been due to her producing dear and excellent things, whilst Germany made cheap and nasty ones. "We know the fine things England makes, but in thousands of cases we buy German goods not because they are cheap, but because British goods cannot be obtained anywhere." Furthermore, Germany supplies goods that England has never attempted to supply. M. Timiriazeff is greatly impressed with Germany's intelligence service for securing reliable information respecting the standing of local Russian firms and the credit that it is safe to give them—its thoroughness is only equalled by that of the military and naval spy system of Germany—it is upon such information that the long-credit system is built up. In the slump that follows the war in all manufacturing countries, manufacturers will be looking round to discover scope for their energies; Russia needs the assistance of outside nations; if the British want to reap trading benefit from the friendship between the Allies, they have got to move now! He says that we need to study what Russia wants, to have representatives there who will speak Russian, and to conform to the Russian habit of long credit.

So much for the outlook as seen by M. Timiriazeff, and the lessons which need to be taken to heart by us. But there are shortcomings on the Russian side too, and such weaknesses, with some of which we have dealt briefly on several occasions, are plainly stated by Mr. Foster Fraser in his eighth article (July 19th). "Russia is the land of officials"—"every little Russian born has a glow in his heart that he may be an official"; and those who wear uniform "have a superiority towards trade." Every official has a superior official over him, and it is the first rule of self-preservation to say "No" to every application lest the official should get into trouble from someone above him. If one wants to start a business in Russia, says the author, the way is long and tedious. "You have to get permission to start a company, and there are half-a-dozen departments to be consulted, every one of which is antagonistic, and has to be overcome." Englishmen have complained that the official attitude of Russia is to discourage commerce instead of facilitating it. Then in regard to "palm-oil," that not very wholesome lubricant, in regard to which we are not always above reproach at home, the practice in Russia "is so common that it may be described as a national institution for everybody to make 'a bit on the quiet' before he does his duty." Municipal obstruction and other similar matters are also touched upon, and Mr. Fraser says: "If you bring any of your English nonsense with you about going ahead on straight business lines . . . . . you will find you are checkmated." He agrees that there are honourable and unbribable officials in Russia, but in the foregoing, and in more like it, he says that he has reflected the invariable story told by Englishmen resident in Russia, some of them for a quarter of a century and more. The author, writing as a sincere friend of Russia, aware of the cordial feeling toward Britain which exists in the country, fully admitting that it is the duty of English manufacturers to be adaptable to the Russian market, adds that the business adaptability should be reciprocal, "and that the powers that be in Russia would do well if they endeavoured to purge their country of a practice which no Russian defends, though he may be clever in finding excuses." Russia wants foreign capital; its prolonged credit system, generally described as a national custom, is really an admission of shortness of capital. British capital and enterprise will be there, says the writer, if Russia simplifies and consolidates her commercial laws.

The Odessa Branch of the Russo-British Chamber of Commerce is actively developing a programme of work designed to assist British trade. A Russo-British trade conference is suggested. At Petrograd, too, there is a similar movement, and the display of British manufactures at the Nijni Novgorod Fair is advocated.

THE CENTRAL POWER STATION OF THE RANDFONTEIN ESTATES.

By R. TURNBULL MAWDESLEY.

(*Continued from page* 83.)

The alternators are all designed to deliver three-phase current at a frequency of 50 cycles and at a pressure of 6,600 volts between phases. All have revolving fields, the 6,000-KW. sets having the cylindrical type, and the smaller units salient poles. The generators are designed to give the full output at ·7 power factor, but actually the average power factor is higher than this, as will be shown.

The exciters are shunt wound, with compensating windings, the pressure being 125 volts. The excitation current is led to common bus-bars, and the exciters may be run in parallel, or individually—an arrangement which allows an alternator to be run without its own exciter if necessary.

The whole of the switchgear was supplied by the British Westinghouse Electric and Manufacturing Co., Ltd.

The smaller machine switches and all feeder switches are remotely controlled and mechanically operated, while the main switches of the three 6,000-KW. alternators are electrically operated. A view of the main board is given in fig. 6 (p. 82); and in fig. 9 the auxiliary power board is shown, with a partial view above of the feeder panels, and, in the rear, the concrete and brick structure containing all high-tension apparatus.

This structure runs parallel with the operating platform, and contains two sets of bus-bars. Selector switches allow any feeder or any generator to be connected to either top or bottom bars, and the current and pressure transformers are, as usual, placed in cubicles, each phase in its own chamber.

A bus-bar coupling switch, mechanically operated, allows of the bars being paralleled, and feeders may be changed over in this manner.

The generators are protected by overload relays, the trip circuits being actuated by direct current from a small battery of accumulators, which is charged by a small induction motor-generator. The feeders are protected by overload relays with inverse time limits; and also by a Merz-Price balanced system, the trip circuits being as above. Each generator panel is provided with three ammeters, a voltmeter, a power factor indicator, and an indicating wattmeter, besides the ordinary integrating wattmeter and a recording ammeter. The feeder panels are provided with three ammeters only, the integrating watt-hour meters originally installed now being disconnected.

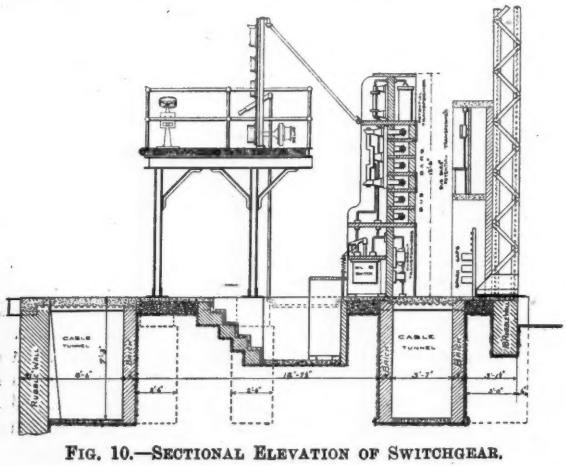


FIG. 10.—SECTIONAL ELEVATION OF SWITCHGEAR.

The generator windings are star-connected, but the neutral is not earthed, although series transformers and meters have been inserted in each phase, in case such a procedure should become advisable.

The synchronising is accomplished by means of three synchroscopes, all in parallel, one being of a large size, visible to the drivers from all machines—the two smaller ones, which are more accurate, being used actually for paralleling.

British Westinghouse spark-gaps, with series and shunt resistances, are connected to each set of bus-bars to relieve any undue pressure rise, and static ground detectors, for each set of bus-bars, are placed on the switchboard operating panels. These detectors are connected to condensers inserted in each bus-bar, and they form the sole H.T. apparatus on the operating platform.

A section of the cubicles and operating platform is given in fig. 10.

The station auxiliaries are supplied from a bank of transformers placed in a sub-station at the eastern end of the engine room. This bank consists of three 500-KW. single-phase transformers which reduce the pressure to 550 volts, at which pressure all station motors are operated. Station lighting and the lighting for the married and bachelor quarters is provided for by a further reduction to 120 volts.

All the station, switchboard, and boiler-house lighting circuits are provided with change-over switches, so that in case of a shut-down the battery supplying the trip-circuits may be utilised. The auxiliaries, including artesian-well pumps, are, with the exception of the crane motors, driven in every case by induction motors, and represent an installed capacity of 2,000 KW. The crane motors are direct current, supplied from the small induction motor-generator or the battery.

Referring now to the boiler plant, the general lay-out will be seen from fig. 11. There are 24 boilers in all, of the Babcock & Wilcox standard "Land" type, with integral superheaters, and with mechanical chain grate stokers. The 12 economisers are of the well-known Green make, and the induced-draught plants are by Messrs. Davidson & Co., Belfast.

Each boiler has 4,780 sq. ft. heating surface, and is capable of evaporating 17,000 lb. of water, from and at 212° F. The boilers are arranged two in a battery, and two batteries form a unit, which unit constitutes a self-contained boiler plant, consisting of four boilers, two economisers, feed-pumps, induced-draught plant and stack.

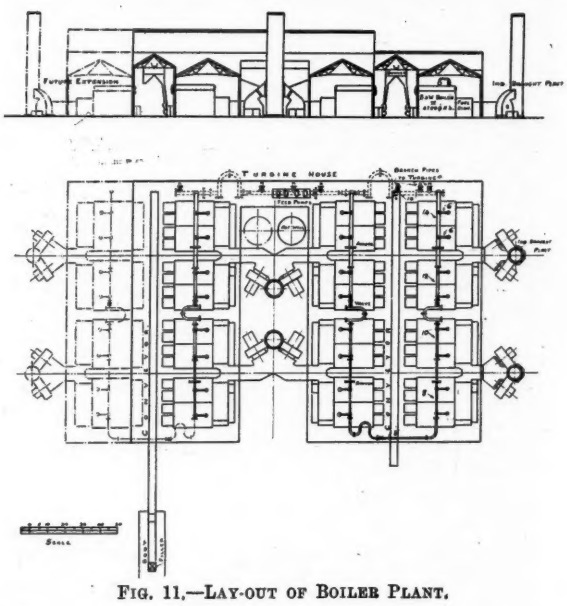


FIG. 11.—LAY-OUT OF BOILER PLANT.

This design was adopted by Mr. T. P. E. Butt, the consulting engineer, when the original plant was laid down, and when it was not known even approximately what the ultimate capacity of the station would be.

There can be no doubt that this arrangement, and the placing of the boiler houses at right angles to the engine-room, has proved an excellent one, as much for the original plant as for the large extensions that were necessary.

As will be seen from the general arrangement of the boiler-house, where two lines of boilers are placed back to back, the two stacks and induced-draught plants are replaced by one. The working pressure of the boilers is 160 lb. per sq. in.

Each superheater has 900 sq. ft. of heating surface per boiler, and raises the steam temperature to 500° F.

"Mixing" valves are provided, to vary the proportions of saturated and superheated steam, until the desired temperature is obtained.

The chain grates, two per boiler, each grate 5 ft. by 12 ft., provide 120 sq. ft. per boiler, a ratio of heating to grate surface of approximately 40 : 1. The grates are driven through the usual gear boxes, having four speeds, which allow the grate to travel between 5 ft. and 31 ft. per hour.

The fire thickness can be varied from 2 in. to 8 in., and motion is given to the grates through worm reduction gear boxes, one for each four boilers. The reduction gears are driven by 6-H.P. induction motors.

Ash tunnels run under each row of boilers, with rails and trucks for the reception of ash and clinker deposited from the chutes below the backs of the grates. From this point the ashes are conveyed by mechanical haulage to a dump.

The economisers are placed immediately to the rear of the boilers on the same floor level. There are 320 tubes for each battery of two boilers, equivalent to 1,600 sq. ft. of economiser surface per boiler. The usual by-pass flues are arranged under the economisers, in such a manner that the boilers may be in service while the economisers are laid off. The scraper gears are driven by 2-H.P. motors.

Referring to the induced-draught plants, the outside, or smaller units, consist of two 55-in. Sirocco fans, one steam driven, the other electrically by a 60-H.P. variable-speed induction motor. These fans are capable of exhausting 120,000 cb. ft. of gases per hour, at a difference of pressure of 1 in. water gauge, the stacks being 7 ft. in diameter by 60 ft. high. The larger, or inner, units consist of two 75-in. Sirocco fans of 230,000 cb. ft. capacity, one coupled to a Belliss engine and the other to a 120-H.P. variable-speed induction motor. The general appearance of No. 2 boiler house was shown in fig. 8.

Under normal conditions the steam fans, which exhaust to atmosphere, are not used, it being, of course, a more economical procedure to run the electric fans, the speeds of which are controlled through tramway-type controllers and metallic resistances inserted in the rotors.

The feed pumps, consisting of six of the Weir type, and one steam turbine pump, constitute the only auxiliaries which are permanently steam driven. These pumps are coupled to a duplicate system of steel piping, one going to the boilers by way of the economisers, the other being a direct "cold" feed.

The boiler feed water is obtained from three artesian wells sunk in the vicinity of the power station. The water from these is delivered into two reserve tanks of 80,000 gallons capacity, placed immediately outside the station. Connections are taken from these tanks to two feed tanks situated inside the boiler houses, and also to the feed pumps direct, to allow of cleaning the feed tanks when necessary. The exhaust steam from the feed pumps passes through pipes submerged in these tanks, as usual.

Further connections for feed water "make-up" are provided for emergencies—one connection being to the Rand Water Board's system, and the other to the condenser circulating pipes.

The normal load of the station is carried by 16 or 18 boilers, which allows at least four boilers (*i.e.*, one boiler unit) to be laid off for tube cleaning and general repair.

There are two main exterior coal bunkers, each of 1,000 tons capacity, and, in addition, each boiler house is provided with an overhead bunker of 270 tons capacity. Coal is delivered to the overhead bunkers by means of two bucket elevators, capable of raising 40 tons per hour. These elevators are fed from the main bunkers by belt conveyors operated by a 20-H.P. motor. The elevators are driven each by a 10-H.P. motor situated above the overhead bunkers, the coal gravitating from these bunkers through chutes leading into the grate-hoppers.

Transvaal and Delagoa Bay "dross" coal is used, having a calorific value of about 11,000 B.TH.U. The sustained load is sufficiently constant to obviate the necessity of forcing the boilers under steam, and the result is a *practically smokeless combustion*, as will be seen by reference to fig. 3.

It should be noted that the two slender stacks, 120 ft. high, shown in this view, form no part of the boiler house equipment. These are the remains of the original steam hoisting plant for the shaft, whose headgear is visible in the view.

The sub-stations, 10 in number, are of two standard capacities, viz, 6,000 KW. and 3,000 KW., the transformer units being in each case 500 KW. single-phase, having two ratios, 6,600 v. to 2,200 v., and 6,600 to 550 volts. The connections on both H.T. and L.T. sides are in mesh, and allow two transformers to furnish a temporary supply of 80 per cent. of the capacity of the balance, in case of one transformer failing. The switchgear in the sub-stations is on a level with the concrete and brick cubicles containing the H.T. apparatus, and except that the oil switches are mechanically operated, all apparatus and arrangements are identical with the power station switchgear. The whole of the transformers and switchgear were supplied by the British Westinghouse Electric and Manufacturing Co., Ltd.

All H.T. feeders are three-core, paper-insulated, with lead covering and steel tape armouring. The method of laying is burying direct in the ground at a depth of 2½ ft. Joint boxes are not used, the conductors being connected by double telescope joints, which, when insulated, are covered with a lead sleeve, and the whole sealed by a plumber's wiped joint.

Trifurcating boxes are used at the terminals. A layer of rock from the mine waste dumps is laid above the cable routes to minimise the danger of mechanical damage due to pick holes, &c. These cable routes are, of course, wholly upon the company's property; and so effective has been this method that no mechanical damage has yet resulted in seven years.

The cable route, from one end of the Estates to the other, forms practically a straight line, and the method of dealing with this arrangement has been to allow the bus-bars in each sub-station to form part of the transmission line.

All sub-stations contain two sets of bus-bars, the cables being led into each sub-station, and connected to either set of bus-bars. The incoming cables connect to one end of the bus-bars, and the outgoing feeders to the other end, the local supply being tapped off between these points. Section pillars are inserted in the line at distances of approximately 500 yd., in order to sectionalise the cables for fault localisation and testing; and all cables entering and leaving sub-stations are protected by the Merz-Price balanced system.

Distribution from all sub-stations is made by underground cable at either 2,000 volts or 550 volts, so that transformers are protected from lightning troubles on both sides. Lighting is provided for by overhead lines from special transformer kiosks at 120 volts.

Unlike the V.F.P. Co.'s system, no trouble whatever from lightning is experienced, as the whole of the H.T. transmission is carried out underground.

The capital cost, excluding the recent extensions to the buildings, the installation of the 6,000-KW. Westinghouse set, and sub-station extensions, was £303,000, made up as follows:—

Boiler plant	£121,000
Cooling towers, piping, &c.	13,000
Generator and condensing plant	97,000
Sub-stations and transmission cables ...	45,000
Building	11,000
Workshops, artesian wells, &c.	16,000
	£303,000

To this must be added the cost of the open-spray cooling pond, additions to steam plant, as above, and the extensions to sub-stations and transmission cables, &c., bringing up the total capital expenditure to slightly over £500,000.

The working costs for the month of March, 1915, are given below. These costs are steadily falling as the load increases, and form a fair average at the time of writing:—

Units delivered to consumers	9,049,923
Units dispatched from switchboard ...	9,580,540
Cost per unit dispatched	·1904d.
Operating costs, including coal	·1527d.
Steam generating plant maintenance ...	·0185d.
Electric plant maintenance costs	·0087d.
Workshop and buildings maintenance costs	·0031d.
Main switchboard control costs	·0074d.
Total per unit ...	·1904d.

The cost of coal at the pit mouth is 2s. 9d. per ton, and the cost delivered at the power station is 9s. per ton, so that railway freightage forms the most expensive item in production.

(*To be concluded.*)

THE TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION CONGRESS, 1915.

The seventh annual congress of this Association was held on Friday last in London. The proceedings were naturally severely curtailed owing to the war; the members met at the Institution of Civil Engineers, where three papers, by Mr. A. V. Mason (South Metropolitan Electric Tramways and Lighting Co.) on "Glimpses into the Obvious," Mr. J. W. Dugdale (Oldham) on "Tramways during War Time," and by Mr. W. H. L. Watson on "Electric battery vehicles as adjuncts to Tramways," were read and discussed, and in the evening an informal dinner was held at the Trocadero Restaurant. The Chairman, the Hon. Arthur Stanley, in opening the proceedings, extended a hearty welcome to the visitors, and dealt briefly with the report and accounts, from which it appeared that, due to unforeseen and exceptional expenditure, the year's working had resulted in a very small deficit; the Association, however, has a surplus of some £300 in hand which has been invested in the War Loan. He referred sympathetically to the loss of three of the Association's earliest members, Messrs. Holliday, Gordon and Tresilian. They had several committees sitting, and had recently had an opportunity of giving evidence before the Local Government Board on questions relating to maintenance of tramway tracks, and were hopeful that some official effect would be given to some of their recommendations. During the year a special committee submitted a useful report on tramcar controllers, and at the present time they were in communication with tramway managers and others on the subject of supplies during war time. The question of approaching the Munitions Department is being considered with a view to ensuring a sufficient supply of materials for stock, in order to prevent curtailment or stoppage of tramway services, and the Council had passed a resolution requesting the Minister of Munitions to receive a deputation at an early date in order to urge their case.

Six members of the Council retired by rotation: Messrs. Coutts, Edwardes, Fell, Parshall, Thom and Tegetmeier, and a seventh vacancy was caused by the death of Mr. Tresilian; to replace them, the names of Mr. J. B. Tippetts (B.E.T.), Mr. Ernest Hatton (Newcastle-on-Tyne), Mr. H. L. White (Great Grimsby), Mr. C. D. Stanley (St. Helens), Mr. W. G. Verdon-Smith (Bristol), Mr. James Devonshire (Metropolitan and London United Tramways), and Mr. W. T. Robson (Southampton), were put forward and subsequently elected, the report and accounts also being adopted.

Mr. A. V. Mason's paper dealt very largely with small details of traffic working, more particularly as affecting the staff, and contained but little of a technical character, the author very truthfully describing it as a "ramble." However, amongst a number of "tips" with which the paper concludes, we note one or two suggestions which may appeal to technical readers. The author suggested that trolley wire guards should be placed on open deck cars, made of bent iron painted with aluminium and earthed; these could carry the lights for the top, and save people from being hurt by dropping trolley poles or falling trolley wires. He also said he would not waste time over meters, and has latterly tried a bonus system, paying 1s. a week to every motorman who keeps below the prescribed limit, with so far satisfactory results. An account in the aggregate of total units allowed per day per type of equipment was kept of each day with a daily plus or minus, so that if the driver had one unit in hand he received his bonus. The author also suggested the utility of an illuminated sign where a car terminus is hidden from view, to show intending passengers whether it is worth while to "hustle," and advanced the opinion that the present gaudily-painted cars and semi-military uniforms could profitably be replaced by cars in natural colour woods, stained and varnished, and plain uniforms. In reviewing his paper he expressed a dislike for the collection of fares on top decks, and to passengers ringing to stop cars as being a cause of accidents. He regarded tramways as being very poor advertisers of their own wares, and considered that high speed was everything.

In the discussion which followed, Mr. Ernest Hatton disagreed that the bell punch gave sufficient information to be useful as a running check. Inspectors were a necessary evil, and it was better to obtain them from some other system, while as to spare men, working part time, they must have a reasonable living wage. He agreed that illuminated signs at stopping places were a good thing if they did not cost too much.

Mr. C. D. Stanley agreed that high speeds were desirable, but they led to increased car maintenance.

Mr. Dugdale said a plan for interchange of inspectors would be desirable. He was not an advocate of the P.A.Y.E. system, but thought that fares could often be collected on the platform by a man who knew his business. In his opinion, every passenger should have a ticket, even if it were a free one, and spare list men should have a living wage.

Mr. White said he had an arrangement by which he exchanged inspectors with a neighbouring system for short periods. The bell punch was not suitable as a running check. He believed the author's suggestion to use a bamboo pole instead of a rope for shifting the trolley pole was being generally adopted.

Mr. Edwardes disagreed as to the utility of the registering bell punch, especially when there were transfer tickets, etc. Often those who had them never looked at the register. By regulating duty, spare men could be given fairly full employment. As a strange inspector became known to the men after a week or two, there was not much point in passing over their own men.

Mr. Howley emphasised the fact that the tramways were out to cater for the public, and therefore high speed was required, and it was not possible to prevent passengers from ringing bells. At Gateshead the P.A.Y.E. system was adopted on some routes and worked well on single-deck cars, the fare being a uniform penny one; but at the terminus in rush times they had trouble with change. They found that platform accidents were decreased owing to the conductor being always there. The driver's seat suggested by the author was possible with power brakes, and he was rather of opinion that all heavy cars would have to be fitted with power brakes.

Mr. T. B. Goodyer upheld the value of the bell punch; his view on the matter of cheap fares was that all fares should be made as low as possible and preferential treatment eliminated; the early worker who gave up early had no more right to cheap fares than the late starter who worked till late.

Mr. C. J. Spencer said his practice at Bradford was to promote inspectors from his own staff, but it depended on the size of the staff, and might not be easy with a small one. The spare list was the "gateway" to the undertaking and should attract good men, and it was possible so to arrange it, from known staff data, that there would be little dead time. Mr. Spencer then dealt with the question of official recognition of the staff, and said he had succeeded in getting from the Munitions Department a recognition that tramways carrying munition workers should be kept going, and it was possible that badges would be given to men engaged in such services.

Mr. Harry England (who took the chair, owing to Mr. Stanley being called away), in closing the discussion, said he thought it would be possible to save a good deal in the painting of cars and yet not render them less attractive.

Tramways during War Time.

Abstract of paper by J. W. DUGDALE.

It is known to all heads of tramways that the total capital expenditure of the undertakings in the United Kingdom amounts to £80,977,838. It is, therefore, a transparent fact that the systems are a great asset to the nation, especially when the rateable value and the upkeep of the roadway are taken into consideration.

The number of tramway employés who have given their services for this great European war reaches a total of 18,057, which is an average of about 30 per cent. of the total number of men employed on tramway undertakings. Every man has gone away with the comforting assurance that his dependents

would be looked after, and that were he spared to come back his situation would be open for him. The cost to the departments mentioned for allowances or grants per week at the present time is very high, viz., London County Council, £1,568, Glasgow £1,000, Liverpool £520, and Manchester £1,360.

The granting of payments to dependents, I think, ought to have been a subject for discussion between representatives of municipal and company-owned tramways at a conference.

This would have been the means of a more uniform rate of pay being adopted. I am of opinion it would have been a much better arrangement if this burden of expenditure could have been, by some means, divided amongst all the departments of the corporations, either equally or on some *pro rata* basis.

A number of undertakings are experimenting with female labour on the cars, and in the near future this is bound to extend to other work in the department. I am not very much in favour of employing women conductors, unless it becomes absolutely essential, especially on tramways running early workmen's cars (which are generally overcrowded); and, again, I do not think that a woman is physically strong enough to bear the strain of ascending and descending the steps of double-deck cars for any length of time, neither is she capable of carrying out the heavy parts of the work of a guard. Of course, the conditions of each tramway differ considerably.

I find in Oldham that the hasty training of men to fill the motormen's positions has been the means of increasing my electric energy bill as much as £20 per week for considerably less mileage. I have to pay 1½d. per unit for energy, which is very costly.

The question of paying a war bonus to tramway and other corporation employés has occupied the attention of the majority of committees during the past few months. Personally, I think that the corporation employé (who is, in a great number of instances, in a much better financial position than an employé of a private firm, and who has regular hours, no short time, etc.) ought not to be granted this concession. It amounts to an additional tax upon the ratepayers, more particularly in rate-aided departments of a corporation; and perhaps a ratepayer earning, say, £1 per week, will have to bear his share in paying a much better wage and war bonus to a man engaged in his own class of work in the employ of a municipality.

There is, without doubt, a great scarcity of skilled men in every tramway workshop, owing to them having been drafted into private workshops engaged in manufacturing munitions of war, and tramway concerns are now handicapped in obtaining quick deliveries of material, such as car wheels, axles, tires, etc., owing to the makers not being able to execute orders promptly on account of pressing Government work. The same applies to fittings for motor vehicles. I would state that a recent order I have placed for tramcar tires has been given at an increased price of 50 per cent. over what was paid twelve months ago, and have been waiting three months for the delivery of an engine crankshaft.

There will be a great rush for tram rails in the very near future, as the life of those laid in the year 1900 on many systems will become exhausted. This is a very important factor, which will have to be closely watched, as the prices per ton will increase considerably. Already tram rails have advanced in price to £9 5s. per ton.

A large number of tramways have granted free riding facilities to soldiers in training, wounded soldiers going to and from hospital, refugee children going to and from school, etc., and this concession has cost the Oldham Tramways Committee as much as £50 per week. To be able to ascertain the cost of this privilege I have issued tickets for these free riding facilities.

In the majority of towns the tramways revenue has fallen very much below that of normal times, and this, coupled with the concessions granted, hits tramways rather hard. On the other hand, certain undertakings have benefited during "Pastimes" by reason of the public not travelling far from their homes on account of economy and the curtailment of railway excursions generally.

In the discussion which followed, Mr. C. D. STANLEY questioned whether repairs to the track could be left over, as a bad track meant bad cars. In Lancashire the tramways had to be kept going as workpeople were often dependent on them for getting to work.

Mr. TEGETMEIER considered that with the treatment given to employés on the author's system, the dependents were much better off than in peace time, which was inequitable.

Mr. EDWARDES said small repair shops could assist in munitions work, and in his area the skilled mill mechanics volunteered to assist in the work. If tramway mechanics were engaged in this way there was no reason why they should lose them by enlistment, etc. It would have been better if some general understanding had been come to as to payment of war allowances.

Mr. ROBSON felt that it was too late to open the question of allowances, but the pressing need was to secure the delivery of tramway material.

Mr. HARRY ENGLAND said the Council of the Association had decided to ask for war badges for skilled men, power-house and sub-station attendants, etc., who, it was considered, should be exempt from service. In his own undertaking 50 per cent. of the sub-station attendants, who were naval reservists, left on the first day of war.

Mr. JAS. DEVONSHIRE emphasised the necessity of keeping the skilled men; if they went at a greater rate it would be necessary to shut down some undertakings. The men should be enrolled as munitions workers and certified as such, so that attempts to draw them away would cease. In a certain case a big tramway repair shop had been given up for Government work, the car repairs being turned over to the repair staff of an allied undertaking; he contended that the latter staff were just as much entitled to recognition as war workers as the former, who were directly employed on such work. The motormen and conductors were another matter, but it was hoped that a percentage of these men would be recognised.

Another speaker suggested that a conference might be called to settle the conditions of labour of female tramway workers.

Mr. HARRY ENGLAND having intimated that the Council of the Association would like to have the opinion of the meeting as to the claim for exemption from service being restricted to skilled labour, power and sub-station attendants, etc., a vote was taken agreeing to this.

Battery Vehicles as an Adjunct to Tramways.

Abstract of paper by W. H. L. WATSON.

THE writer's experience during the past three years with many types of battery vehicles has been so satisfactory that he feels justified in an endeavour to direct the attention of tramway authorities to the virtues of this method of propulsion. The past difficulty has been to provide a means of storing electricity; the accumulators put into service were solely of the lead-acid type, which, owing to its great weight and inability to withstand not only high rates of charge and discharge, but also vibration, soon proved commercially unsound. Briefly reviewing the batteries now available, we still have the original flat-plate battery, for which the makers claim great improvement in their method of formation. We also have a new type of lead battery, called the Ironclad-Exide, which differs in many respects from the older type, and which the writer believes to be the best of lead accumulators. Both of these types of batteries have the inherent troubles of all lead accumulators, but by careful maintenance and strict adherence to the manufacturers' instructions a good case can be made in their favour for certain classes of work. Another type of battery which is finding much favour in this country is the Edison nickel-iron cell, the introduction of which has opened to the battery vehicle a sphere of usefulness in which no other battery can successfully compete. This accumulator is built throughout of nickel and steel, the electrolyte being a solution of potash and lithium. The time available will not permit me to detail the differences of the three batteries named, beyond showing in mileage and money the performance to be expected with each type. The following table will show the desired information, and it will be for those interested to decide whether it is better to pay a smaller initial cost with a heavy maintenance charge or a heavier sum with a proportionate saving in these later expenses.

COMPARISON BETWEEN THREE DIFFERENT TYPES OF BATTERIES OF 150/165 AMPERE-HOUR CAPACITY.

150 A.H. Flat-plate	11-12 KW.H. ...	List price, £85
150 A.H. Ironclad-Exide ...	11-12 KW.H. ...	,, ,, £150
150 A.H. Edison Nickel-Iron	11-12 KW.H. ...	,, ,, £216

TOTAL COST OF OPERATION OVER 60,000 MILES SERVICE.

	Lead.	Iron-Exide.	Edison.
Guaranteed mileage ...	nil.	18,000 to 20,000	60,000
Plate maintenance ...	1½d. per mile.	—	—
Fair mileage to expect	6,000	20,000	150,000
Original cost	£85	£150	£216
Plate maintenance for 54,000 miles at 1½d.	£337 10s.	—	—
Renewal of plates at 70 per cent. of original cost (£105) × 2, representing 40,000 miles	—	£210	—
Plate maintenance ...	—	—	nil.
Total cost of battery at completion of 60,000 miles	£422 10s.	£360	£216

In towns such as Morecambe, Lancashire, where the conduit system is barred owing to the possibility of interference with the service by incursion of the sea, not to mention the high cost of such an installation, and where the overhead system is regarded as a menace to the scenic surroundings, the battery tram will be of great service. Horse trams have operated successfully for many years. With the advance of time electric traction has been seriously discussed, with the result that a scheme for installing battery-driven trams was considered, whereby a capital expenditure of, approximately, £18,000 was involved for the installation of twelve fifty-six-passenger, double-deck trams, and the necessary depôt complete with charging equipment and the extension of mains. The running costs were guaranteed not to exceed 5½d. per car mile, covering write-off of capital, labour, and all running charges. If this installation is made it will be the first of its kind in this country, but there are existing trams working on this principle in the United States. It is interesting to

note that battery rail cars, capable of carrying forty passengers with a total weight of fifteen tons, average a current consumption of 600 watt-hours per car mile; maximum speed thirty miles per hour; miles per charge of battery 100.

The battery omnibus will probably prove to be the more popular method of building up routes, prior to the extension of a full tramway service, owing to its cheaper installation and greater mobility. These 'buses are already installed in Southend, South Shields, York, West Bromwich, and Loughborough. In the first three instances the results have been very gratifying, the vehicles not only having given a highly satisfactory service, but the low running costs expected having been proved conclusively. At Southend-on-Sea, where one battery-driven 'bus was installed to run on equal terms with a fleet of petrol and petrol-electric 'buses, a saving of 2d. per mile, plus halfpenny profit to the electricity department, making a net saving of 2½d. per mile, has been shown in favour of the battery vehicle.

At South Shields I find that the current consumption per mile varies between 1.63 and 2.10 units, the variation being specially noticeable owing to the road surface conditions encountered and variable weather. The maintenance charges have proved very slight, and with such a low average weekly revenue as 5.92d. the service covers expenses.

At York Mr. Hame announces that the four Edison 'buses have run 13,600 miles with an overall energy consumption of 1.1 units per mile.

The installation of 'buses at West Bromwich and Loughborough has only recently been made, consequently running costs are not yet available. They will be of special interest, as they are to cover routes previously occupied by petrol-driven chassis.

The ideal method of employing these vehicles is to fix a terminus at which point the vehicle awaits passengers for a few minutes. Here current can be taken at a high rate of input. The time taken to replace sufficient current (at six times the normal rate) to cover one mile of even road surface is one and a half minutes. Therefore, a stay of four and a half minutes will in many cases replace sufficient current to cover the major part of a journey. At Southend-on-Sea it is no infrequent occurrence for the battery 'bus to return to its garage at night with no more than 40 ampere-hours used out of a total capacity of 300 ampere-hours after a day's journey of 100 miles. Where "boosting" facilities cannot be arranged, a larger size battery may be necessary; but a mileage per day of 45 to 50 miles could easily be accomplished, provided the district is not of an extremely hilly nature. Upon hills the vehicle proceeds at a reduced pace, and where considerable gradients are met this is sometimes reduced to little more than a crawl. It should be appreciated, however, that it is possible to run 'buses under these conditions at a running cost which will render light services profitable, or at least self-supporting, whereas either petrol or petrol-electric 'buses would prove uncommercial.

It must not be assumed that the battery vehicle is incapable of speed; speed can be accelerated provided the current supply is in proportion to the distance to be traversed. The "electric" has been developed to travel at a useful speed under the most economical conditions. It is a peculiarity of the vehicle that when under way it appears to be journeying at a much slower speed than the mileage really registered. Including stops, it has been found capable of averaging a speed of 7½ miles per hour. This compares very favourably with the London 'bus, whose average rate of travel is approximately eight miles per hour. It seems unwise to develop a new route under speed conditions, which can only result in a short life owing to the high running costs. The service will be much better appreciated if it is run upon conditions which the route can afford, thereby ensuring permanency.

Where the district is so scattered that a vehicle becomes a matter of necessity to the manager when doing his round of inspection, an electric roadster or coupé seems an ideal car to suit his purpose.

But for the condition of the country during the past year a new vehicle would have been placed upon the market suited for the conveyance of members of the staff on their duties. This vehicle is designed on very light lines similar to the petrol-cycle cars, which have become so popular. It is believed that such a vehicle would find much favour as a means of conveying inspectors, also for the collection of coppers, distribution of tickets, etc., etc. This vehicle it is hoped will not exceed a cost of £300. Upon a similar chassis will be mounted a trade body of the box variety. This has been specially designed for the use of tramway departments in connection with their parcel delivery service. Here, again, low price has been given the utmost consideration—initial cost will be approximately £270. So great will be the advantage of such a vehicle to parcel delivery services that it seems likely a number will be employed once the low running costs have been suitably demonstrated. Assuming that an average mileage of 30 miles per day is accomplished during 300 days per annum, and current can be obtained at 1d. per unit, including current, maintenance, tires, insurance, depreciation (seven years), and interest at an average rate of 5 per cent., the total running costs will not exceed 2½d. per mile.

The tramway departments of Ilford, Derby, and Belfast employ battery-driven tower wagons, each of which amply satisfies their requirements. These vehicles have a speed of from 11 to 12 miles per hour, which is generally found sufficient for the traffic to be negotiated. When out of service the opportunity is seized to revive the battery. The mileage available per charge is from 40 to 45 miles, which has proved more than sufficient for a day's work.

The battery will provide current for operating electric drills, saws, and riveters for bonding, and any other small tools in which either power or heat is required. It will be easily realised what an immense advantage it is to the testing engineer to have a large capacity battery at 70 volts available at any section or feeder pillar for testing purposes during times when the network is dead.

For maintenance of the track and road repairs a vehicle of two or three tons carrying capacity would be of great general utility. For carrying materials such as pillars, setts, and other weighty equipment required on permanent tracks or extensions this vehicle will do all that is required, and by provision of an interchangeable tank body of 500 gallons capacity a further field of usefulness will be provided for watering at any time when current is not available. This same vehicle has been utilised for carrying cables and drawing them into the ducts. It may sometimes be found useful for removing cars from a section where a breakdown has occurred, thus releasing the vehicles to proceed on their journey.

In the short discussion which followed Mr. Watson's résumé of the paper, Mr. W. T. Robson mentioned his satisfactory experience of the working of battery 'buses at South Shields. Such a 'bus would mount a short steep gradient as quickly as a petrol 'bus, but on long steady gradients its speed fell off seriously, and this would have to be altered. It was excellent for service on flat roads, such as those round York, and the passengers liked it. The Shields battery 'buses gave no trouble in maintenance, and were charged at night by unskilled labour. The only maintenance work was the cleaning of controller contacts and filling up the batteries once a week. The design was very good indeed, and he asked whether it would not be possible to overcome the speed difficulty by the introduction of an arrangement for switching extra cells in on hills. The cost of the battery 'bus, however, was very much too high, and, unless it was reduced, petrol 'buses would be adopted in preference.

Mr. Harvey recommended every tramway manager to get a battery tower wagon. The one used on his own undertaking cost about £675, and had a speed of some 10 to 12 miles an hour. In addition to its normal work, it would lift a 60 ft. tramway rail; it had given no trouble in service.

Mr. Wyld referred to the tests carried out at Hampstead with electric dust vans and to the considerable saving in cost experienced over horse traction.

Mr. Watson, in reply, said experiments were being made to overcome the speed difficulty referred to by using change-speed gear. He suggested that extra cells would introduce difficulties in the charging, etc. He agreed that high first cost was an obstacle, but those who paid the price did not seem to be dissatisfied with the result. In conclusion, he mentioned that the Derby tramways were now using an electric tower wagon and were considering the purchase of battery-driven 'buses.

Mr. England, in closing the meeting, said, in reference to the prevailing difficulty in obtaining tramway material, that some concerns were very short, and as an Association they must press the Government to facilitate delivery of such material. Further, in order to save expense, etc., it was intended to ask the Board of Trade to incorporate any proposals for extension of time for carrying out Provisional Orders, etc., in one Act.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electric Power in India.

I note that the columns of your issue of May 28th contain an abstract of the paper written by Mr. H. R. Speyer on "Electric Power in India."

This paper contains so many statements which are likely to mislead your readers that I think it is the duty of British manufacturers to draw attention to these statements and to the author's interest in German-made plant.

For several years prior to the date of Mr. Speyer's paper, he represented in India the interests of the Lahmeyer Electric Co., and latterly, on the amalgamation of this company with the A.E.G. Co., the interests of the combined concern, which was known under the joint name of the "A.E.G. Lahmeyer Co." During this period Mr. Speyer acted in a dual capacity as consulting engineer and also as representative of the above concern, and claims to have imported from Germany electrical plant aggregating about 20,000 H.P. for various customers, whom, presumably, he was advising in his capacity as a consulting engineer.

One would imagine from reading Mr. Speyer's paper that Germany and the Continent had supplied the great bulk of

the electrical machinery which has been installed in India during recent years. He states that a very large portion of the electrical plant installed in India has been supplied from the Continent, and goes on to give figures in regard to a few of the generating stations in India showing where this plant has been installed. A reference to the official Government publications in regard to machinery imports throws a very different light on the state of affairs.

During 1908-09 the total value of electrical machinery imported into India was approximately 36 lacs, and of this amount Germany's portion was Rs. 69,000/-; that is to say, under 2 per cent.

In the following year the figures were approximately 32 lacs total, and one lac from Germany, *i.e.*, a little over 3 per cent.

In 1910-11 the total was 42 lacs, of which Germany's portion amounted to seven lacs; and in the following year the total was 42 lacs, of which Germany supplied 4½ lacs.

It will thus be seen that the amount of electrical machinery imported from Germany during the above years averaged considerably less than 10 per cent., and during the same period Great Britain supplied between 80 and 90 per cent. of the electrical machinery sent into India.

It is interesting to note, comparing the official figures with statements which have been made by Mr. Speyer of the amount of business that he himself had done for the A.E.G. Lahmeyer Co., that he must have been responsible for importing at least nine-tenths of the Continental machinery which came into India.

After making misleading statements as to the position of British Trade in India in electrical machinery, Mr. Speyer proceeds to make a wholesale condemnation of British methods of business, British designs and workmanship, and British enterprise.

To leave such statements as he makes uncontroverted would, in my opinion, harm the interest of British trade in India, as the average purchaser reading this paper would certainly obtain the impression that he would be much better served in every respect by obtaining machinery from the Continent.

It is not possible to get official figures in regard to the respective character of British and German machinery in the same way as it is of respective amounts of machinery imported, but those of us who have a knowledge of the electrical business in this country are aware of several cases of bad breakdowns of German machinery and of several cases of equally bad design of plant installed in some mills, and I do not hesitate to say that the proportion of failures to the amount of machinery imported is considerably higher in the case of Continental machinery than in the case of British-made goods.

German machinery has been imported into this country mainly, if not entirely, by price-cutting. The largest electrical generators in India are, unfortunately, of German make, and a serious breakdown has occurred on one, at least, of these machines such as would have made any British manufacturer ashamed of his firm's work.

We all welcome candid criticism and a straightforward statement of manufacturers' mistakes; such, for instance, as is given in the paper which you recently published by Mr. J. H. Rider is welcomed, as it leads to a general advance in the science of electrical engineering.

Mr. Speyer's paper contains little useful information. I have shown how erroneous some of his published figures are, and the remainder of his paper also contains a number of quite misleading statements regarding the position and prospects of electrical business in this country.

I will not take up more of your space by further detail in regard to these points, but hope that you will give this letter space so that those ignorant on the subject may not be misled by the contents of Mr. Speyer's paper, and may take note to obtain confirmation of any statements made therein before accepting them as accurate.

Accuracy.

Calcutta, *June 24th*, 1915.

In your issue of May 28th you publish the first portion of the paper on the above subject written by Mr. H. R. Speyer, and recently published in the *Journal* of the Institution of Electrical Engineers. When the particular issue of the *Journal* in which the paper appeared was received by members of the Institution in India it caused a great deal of indignation, owing to the entirely erroneous impression which the author conveyed therein as to the state of the electrical business in India, and generally to the numerous mis-statements of facts made by him. A meeting of the Calcutta Local Section of the Institution was at once held in order to discuss the paper, and a report of the proceedings has been transmitted to the Secretary in London, together with a request that before papers on matters concerning India are accepted for reading or publication at home, members in India may have an opportunity of expressing an opinion upon them.

Mr. H. R. Speyer, the author of the paper under reference, was the agent in India for the A.E.G. and Lahmeyer companies until shortly before he wrote the paper, and he is still the distributing agent in India for an American-made motor car (the "Hubmobile"), so that it is a little difficult to see at first sight—but at first sight only—why he now poses as a patriotic Englishman, urging *British* manufacturers to wake up, and, presumably, to appoint *him* as their agent in India. This, also, although he now describes himself as a "consulting engineer."

It is not possible in the confined space of a letter to report fully regarding the meeting held in Calcutta, but practically every statement in the paper was refuted and proved to be wrong; and, in view of the extended publicity which you have given to the paper by publishing it, I trust that you will also find space for this letter, indicating the true state of affairs. I enclose my card and remain, Sirs,

British Representative.

Calcutta, *June 24th*, 1915.

I note in your issue to hand by this mail (dated May 28th) that you have published a first instalment of the paper written for the I.E.E. by Mr. H. R. Speyer.

Everyone connected with the electrical business here is surprised that the Institution should have published under present conditions a paper emanating from one who is looked on here as an alien enemy. The author for some years represented two of the large German firms here, and even now finds his chief employment in selling American automobiles, so, to put it mildly, it is the height of presumption for him to pretend any personal interest in the welfare of British trade in India.

Had the paper any real merit there might have been some excuse for its publication, but it is full of inaccuracies, and gives an absolutely false impression of the real state of things out here.

Many of the false statements were recorded in a discussion of the paper at the local centre of the I.E.E., and it is hoped that the proceedings of this meeting will be published in the *I.E.E. Journal*. If this is done, I trust that, as you have published the original paper, you will also find space for a digest of the discussion on it in order to give your readers a chance of finding out what local members think of Mr. Speyer's paper.

"A Ditcher."

Calcutta, *June 24th*, 1915.

Shortage of Labour.

In view of the great need of men for industries in England, permit me to point out that there are thousands of genuine unemployed here in Australia, and a great many of these would, I am sure, be pleased to accept work in England. Many of these men would be in a position to pay their own fare by steamer, and I would suggest that some of the leading firms in the United Kingdom should form a committee to deal with the subject.

If advertisements were inserted in the leading daily papers in Australia, I am convinced that plenty of suitable men would reply. I enclose a cutting from a Sydney daily paper which deals with this subject.

London Lad.

[The cutting shows that the percentage of unemployment, according to Trade Union returns, rose from 5.9 in February, 1914, to 12 in February, 1915, and the latter figure takes no account of men who were working short time or were out of work for less than three days during the last full working week of the month.—EDS. ELEC. REV.]

American Trade.

I shall be glad if you will give the following remarks space in your publication, as I am sure they will lead to a better understanding between American manufacturers of insulated wire and prospective British consumers.

The present abnormal position of affairs has placed the British manufacturers where they must back up their Government with every ounce of assistance, and, therefore, the commercial demands, both their own and European neutrals', must go by the board. Consequently, those suffering from the want of such supplies must turn to probably the only source they can get them from, and that is the United States. Business here for the last year has not been any too good, and therefore American factories welcome such inquiries with a certain amount of enthusiasm. These inquiries are beginning to pour in rapidly, and it is at this point that I wish to point out a way to smooth over the discrepancies arising from the differences in nomenclature between the two countries.

Old England is a very conservative country in its preference for its own standards, but so also is New England, and if the latter is to be of any assistance to the former, and that for probably only a temporary period, it will be necessary to consider to some extent how the latter is fixed in its machinery and equipment. Thus, for instance, the Brown and Sharpe (B. & S.) gauge is universal on copper wire, and sectional area is considered in terms of the "circular mil," and not the square inch. We prefer to strand regularly, namely 7 wires, 19, 37, 61, 91, 127, 169, and so on, or, where extra flexibility is required, use these figures and units of 3 wires, 7, or 19. Paper over strands are made by some concerns, although there are many who do not like it. Only one class of wire ever uses a compound as rich as 40 per cent. pure Para rubber for covering purposes, and that is for the United States Government specifications, the navy, and some of the army departments; railway signal wires take 30 per cent., and twenty years' experience in this line has shown this proportion to be as good as

any, for, to the writer's knowledge, there are many stretches of hundreds of miles of signal wires exposed to all weathers along railroad tracks in this country which are still giving good service, with no sign of deterioration, and which have been up for a longer period than that. The grade known as "National Code," which is used for house wiring, is supposed to contain 20 per cent., but judging from the prices paid at present it would be difficult to understand how it would be possible to put any in at all and be able to sell at the prevailing rate. Recovered tire stock is practically the base, with the necessary fillers and vulcanising mediums. Anyhow, the stuff stands, so what is the use of bettering it? I am enclosing two copies of the "Code" rules governing the manufacture in case any of your readers care to look over them.

Bitumen compound has not obtained a foothold in this country, but paper is used on almost all underground feeder work, and, in fact, anywhere where lead-encased cables are possible. Rubber is rather too expensive, although there are some who use it. There are cases of varnished cambric, but this style of insulation is not called for very much. Multiphase cable of all kinds and "split insulation" are used as in Europe. There are some factories which can make the steel taped type of cable, among the larger ones.

Insulations are what are known as "solid"; that is, there is very little call for "cored" cable, with an inside of Para pure, and another of vulcanised rubber, and as for the triple cover, as per the British Navy standard, there is no such thing. We used to have fads of this kind, white core, red core, and others, but these have died out now, with the exception of some in the Government specifications, and this is only in the case of a pure rubber core next the conductor, which is supposed to prevent the sulphur from attacking the copper. This bugaboo has long since died a natural death, for no compounder puts more sulphur into his mixture than is necessary to vulcanise the mass, so there cannot be any left to do any harm, except in the smallest of conductors.

I am sending under separate cover other specifications, such as those for railway signals, and some of the traction companies, so that any of your readers who are contemplating purchases from us will be able to look them over and make them fit in with what they want. And as long as they can do this without complicating their demands with what are, to us, "unknown quantities," I am sure all of the manufacturers will be glad to sell as much as possible. Keep to the B. & S. gauge and the circular mil, and don't complicate with the mm. under any circumstances, and all will go well.

There are several reliable testing bureaux which are competent to see that orders are O.K. before they leave this country, and the use of them is somewhat necessary, because Americans do not care to do export business except on the terms of "Cash with bill of lading," New York (or other convenient) bank.

Prospective British customers will find the prices very moderate, as there are a great number of factories on this side, more than 50, in fact, and 75 per cent. of these are on or near the Atlantic seaboard. Prices are, therefore, on a very competitive basis, and consequently companies are keen on getting all the business they can at a low margin of profit.

I have made this letter somewhat longer than I intended, but I wish to make myself as clear as possible; and in case there is anything I can do to help a prospective purchaser out, you are quite at liberty to give my address to him and I will do all I can.

E. W. Stevenson.

Brooklyn, N.Y., *July 9th*, 1915.

LEGAL.

OSRAM LAMP LITIGATION.

(*Concluded from page* 70.)

JUDGMENT was delivered in the Chancery Division in this action on Tuesday, July 20th. In the course of his judgment, Mr. Justice Joyce said: This is an action for an alleged infringement of a patent, No. 23,899 of 1904. This patent, among others, was judicially considered by Mr. Justice Warrington in the action of Osram Lamp Works, Ltd. *v.* the "Z" Electric Co.; the defendants in that case were entirely different from the defendants in the present case, and were held to have infringed. The validity of the patent, which was disputed, was upon the evidence there upheld as against those defendants. There was no appeal from the decision of Mr. Justice Warrington, as I understand, the case being settled, as is not infrequent, by the defendants taking a licence. The present case, I am warned, is to go to the House of Lords. The patent in the present case is for "Improvements relating to the manufacture of incandescent electric lamps." To a great extent it is what I may call a chemical patent; and I at once state that I am not bound to be an expert in chemistry, or in anything else, for the matter of that. The Court acts on the opinion of experts whose qualifications can be tested by cross-examination, and weighs the evidence so given and tested. Premising that, I may say there are two claims by this patentee. The first claim, I think, is for the product, and then the second claim is really for the process of making the product. But this patent, according to my reading of it, if and so far as valid at all, is only valid as a patent for the manufacture of tungsten filaments by the method or process or series of processes particularly described in the specification. The patent is not merely for making a tungsten filament, but it is for making by the method or processes specified in the specification, and in my opinion, for nothing else. It appears by the evidence that the usual manner of forming filaments there referred to, as I understand, was to make the materials into—hardly a paste, but a compound of the consistency of thick treacle, and to squirt this through a glass nozzle into alcohol, whereupon the liquid coming from the nozzle into the alcohol becomes set as a firm jelly, and, having stood for a short time, is hardened and tenacious and capable of being handled. Then the patent proceeds:—"And they are then carbonised, in some cases after denitration has previously been effected." I do not think those words "after denitration has previously been effected" are very material. Then follows a paragraph beginning at the 13th line on page 3, it really begins two lines earlier; and this, to my mind, is a very important part of this specification: "The filaments so produced and consisting of tungsten and carbon are then submitted to the following further treatment. First of all the carbon, which has only served as a binding medium, is removed, by subjecting the filaments to the passage of current in an atmosphere of steam and hydrogen and thus raising it"—which in my opinion must be the atmosphere—"to a high temperature. By this process the carbon is completely oxidised so as to form carbonic oxide and a filament of tungsten is left. These filaments are then rendered uniform in a manner similar to that employed in the treatment of the usual carbon filaments, by submitting them to the action of current in an atmosphere of volatile tungsten compounds in the presence of a large quantity of hydrogen, whereby the tungsten deposited equalises the filaments." Then there is a sentence not very important, I think: "The filaments which have been rendered uniform in this way are then sealed in glass bulbs in the usual manner."

The validity of the patent in this action has been questioned on three or, possibly, four grounds: want of subject matter, insufficiency of the directions as to the way in which the invention is to be carried out, and also want of utility of the process, or whatever it is that is patented.

What is it that the defendants do? Of the materials they use they make a paste much stiffer than a mixture of the viscosity of treacle, which paste is used in the manner of making carbon filaments, and this, if it can be called squirting, is squirted as described by Mr. Ballantyne. There are other processes after the mixing, but the stuff is then rolled up and put into a chamber with a hydraulic press capable of exerting a very high pressure. A die is used consisting of a diamond finely perforated, and the stuff is forced through the die by the press so as to make a filament, and is directly received on a card. Then they are dealt with in a certain received on a card. Then it is dealt with in a certain way. That, again, is from the evidence of Mr. Ballantyne.

With reference to the carbonisation of the filament that is produced by thus pressing it at enormous hydraulic pressure, as to whether it is carbonised or not according to the defendants' process in the usual manner there is some dispute. I am not going to involve myself in a chemical discussion as to whether it be carbonised in the usual manner or not; but it is denied, I think with some show of reason, that the defendants do carbonise in the usual manner. I have some doubt as to whether they do or not in the manner indicated or intended to be indicated by the specification. But upon the question whether the defendants take or use the series of processes described in the twelve lines, beginning on page 3, line 10, "The filaments so produced and consisting of tungsten and carbon are then submitted to the following further treatment," or, indeed, whether they take any of them, I do not feel much doubt. Rightly or wrongly, I do not think they use any one of them. They certainly do not pass current through the filaments; they are not subjected to the passage of current in an atmosphere of steam and hydrogen. In my opinion they do not use an atmosphere of steam and hydrogen in the sense in which that phrase is used in the specification or is intended by the patentee. Nor, indeed, in my opinion, do they use steam at all in the ordinary sense of that word.

The hydrogen the defendants use is dry, but it is said, if I understand the matter rightly, that though no steam or water vapour is introduced, an infinitesimal amount of water vapour, or, rather, of the ingredients, or some of the ingredients, which together with hydrogen will make water vapour or steam in the true or scientific sense—not the popular sense condition of the materials necessarily use, to form the filament in the process the defendants use, and in the then condition of the materials necessarily use, to form the filament. This may be so, but this is certainly not, in my opinion, subjecting the filament to the passage of current in an atmosphere of steam and hydrogen as described or indicated in the specification; nor in my opinion is it an equivalent process in the sense in which that phrase is used in patent law; nor do the defendants employ any of the treatment which comes under the head of equalising.

In the circumstances, seeing how many and which of the series of processes or steps prescribed by the specification are omitted from, or not to be found in, the method pursued by the defendants and alleged to constitute infringement, bear-

ing in mind what I have said before as to what the only patented invention here is, I am unable to bring myself to the conclusion that the patent has been infringed by the defendants, the onus being on the plaintiffs; and I hold that it has not been infringed and that this action must be dismissed.

As to the validity, if it were necessary for me to go into the matter I have serious doubts not only as to the subject matter, bearing in mind what the patent is for, but also upon the sufficiency of the instructions in the specification.

With reference to this, I understand that upon more than one point Mr. Justice Warrington relied upon the evidence of Dr. Oberlander. I think I must say that I was not favourably impressed with the manner in which he gave his evidence. If I am to consider him as appearing in the witness-box in the character of an impartial scientific expert, he did not appear to me to be unbiased or as candid as I should have wished, and I am glad that it is not necessary for me to base my decision in this case upon what I might consider to be the result of his evidence.

As to want of utility, it was not much insisted upon, but I do not understand that this patent has ever been worked commercially.

Upon the whole, I consider that the methods and series of processes used by the defendants are so different from those particularised in the specification that there is no infringement, and this action must be dismissed with the usual consequences.

Costs were granted on the higher scale. It is understood that notice of appeal will be given without delay.

HAMILTON *v.* MARCONI'S WIRELESS TELEGRAPH CO., LTD.

(*Continued from p.* 69.)

THE hearing was resumed on Tuesday, July 13th, when Mr. Hamilton, the plaintiff, was further examined by Mr. Eustace Hills upon the agreements for the formation of the new Australian company. There was, he said, first a provisional agreement dated 1912, out of which the agreement of 1913 resulted. By the agreement the price was to be £41,000, in £1 shares, plus a sale of apparatus; the apparatus was subsequently reduced into money, so that together the price might, in round figures, be stated at £55,000, and he claimed commission on that transaction as well as upon a number of ship installations and upon certain apparatus sold to the new company, who took over existing stations and purchased plant for new installations from the defendant company. Witness gave details of a number of ships which had been fitted with wireless by the company during the period of his agreement of service with them upon which he claimed, he said, £10 per ship for the installation and 5 per cent. of the royalty subsidy from ships fitted with defendants' installation through orders secured by him. As to certain ships the defendants' had brought money into Court, and about them there was no dispute. His claim was really under two heads—first, as to lines as to which defendants had not made payments, and secondly, for certain additional ships on lines from which they admitted payment was due for some ships. There was also a claim for an out-and-out sale of an installation for a ship, upon which he claimed a percentage.

In cross-examination by MR. POLLOCK, K.C., the witness said he claimed for any business done by the Marconi Co. within his territory at any time.

Asked what was the limit of time over which he would continue his claim, Witness replied that he should think during the whole of his life, as when he joined the Marconi Co. he took over to them all his business and all his friends. It must not be forgotten that wireless telegraphy was not an ordinary thing that could be picked up anywhere.

On July 14th Mr. Hamilton was further cross-examined by MR. POLLOCK. He was unable to say whether an installation set up, which was within the Admiralty agreement of 1903, would come within his agreement, as the question was one which had yet to be decided. The Australian fleet belonged to Australia; but the New Zealand ships became a branch of the British Navy. It depended upon the agreement made between the Marconi Co. and the Admiralty whether they got something beyond the agreement of 1903 as regards royalties. He would expect to be paid on the value of the apparatus supplied. For seven years before his agreement with the Marconi Co. the British Admiralty was fitting up ships with wireless installations, but at that time there was no Australian navy, and he claimed to have been instrumental in introducing wireless telegraphy to the Australian Government, and the negotiations in regard to it extended over a long time.

MR. POLLOCK, K.C., opening the case for the defendant company, said that from the plaintiff's documents his claim now reached something over £13,000, but it might be that some other sums had to be added to that, so that very heavy liabilities on the part of the defendants were involved. The defendants had been found by the jury in the King's Bench to have committed a breach of their agreement with the plaintiff, and he (plaintiff) had been awarded damages in respect thereof. But his story now was that in addition to the two or three thousand pounds awarded by the verdict of the jury, he was entitled to ask for a further sum of something over £13,000 under the agreement. The work which the plaintiff did within the territorial area specified by the agreement was confined to the period between August, 1910, and March 1911, and he said that during that period the work he did for the company entitled him to the sum of £13,000 beyond the amount awarded by the jury, and that he was further entitled for the rest of his natural life to receive commission upon payments made to the company for work done by them within his territorial area. Commenting upon the terms of the agreement, counsel said the first point was what right did the contract give plaintiff to be paid commission on sales effected by the company for the rest of his natural life. It was argued for the plaintiff that there was no time limit, and that it was, therefore, for the term of the plaintiff's life. For the defence, he (counsel) argued that it was quite unnecessary to introduce a time limit because the agreement contained a margin of time in regard to other matters, and it was for that time alone that the defendants were liable to the plaintiff. In consideration of his services to the company and his devoting the whole of his time exclusively to the benefit of the company, it was agreed that the defendant should receive 5 per cent. on the gross value of the sales effected by the company within the area specified, but the agreement said only so long as he devoted himself to the benefits of the company. The period of the contracts for the installation of ships was 10 years. The system was to hire to the shipping companies the Marconi apparatus, in return for which a subsidy of £250 per annum was paid in most cases for 10 years, and in respect of each ship fitted the plaintiff was to receive £10 and 5 per cent. on the subsidy. That could only be meant to last for the period during which the contract was running. It was not always ten years; in some of the earlier cases it was for three years only. It was necessary to put a time limit in the case of ships, but it was not necessary in the case of the other business. The plaintiff, however, said that he was to receive payment for ever and ever because he had rendered services for a certain period. The agreement ran from May 2nd, 1910, and it was alleged at the trial that from July, 1912, the defendants had not properly treated the plaintiff by giving him information, and that they dismissed him for causes that were inadequate. The agreement said that it was to last for three years, but it was understood that it should be for a further term of three years in the event of the business being satisfactory. The jury had answered the question as to the damage the plaintiff had sustained by giving him £640 up to May, 1913, and for his chance of a renewal £1,700. The jury had estimated the value of the pecuniary benefit from January to May, and the plaintiff was not entitled to say that he could go beyond that verdict and ask the Referee to say that he could exercise the function of a jury and assume that they should have awarded some other figure. As to the second period of three years, the jury had awarded £1,700 as the value of plaintiff's chance of a renewal of the agreement.

In reply to the REFEREE, COUNSEL said that the Judge did not put it to the jury whether plaintiff was entitled to commission during his life. The point had not been raised, nor was it argued at the trial.

MR. EUSTACE HILLS said that it was more than once stated in the course of the trial that matters of construction except in one instance were to be left to the Referee.

MR. STUART BEVAN said that the question of a life-long agreement was never raised.

MR. POLLOCK, continuing, said that the Judge did consider the possibility of a renewal. According to the plaintiff's case, it seemed that they were now only at the beginning of things. The claim to-day was for £13,000, and it was proposed to add all the years of Mr. Hamilton's life to it. If that were allowed he did not know where the company would be when Mr. Hamilton died. It was not, he contended, possible for Mr. Hamilton to substantiate his claim of £2,751 as commission upon the amalgamation of the German company with the Australian company. The claim was made in respect of what plaintiff called a sale to the company, but the transaction referred to was only a taking over. The amalgamated company took over the interests of the Marconi Co. in Australia and those of the German company. That was not like a sale effected. It was simply the formation of a new company to take over the interests of both companies, and so bring together two competing companies in the interests of both. It was a domestic method of handling the business of both, but the plaintiff claimed £2,751 as his commission on that transaction, although he said that by his agreement he was to get £1,200 a year from it as managing director. As there was no security of tenure with regard to that appointment, the jury had been asked to say what was the value of the plaintiff's expectations in that direction, and they answered the question by saying that it should be £1,700. Dealing with the several heads of claim, Counsel said that the plaintiff's view seemed to be that until he came on the scene in 1910, Australia, so far as wireless was concerned, might be said to be a dark continent. The true position of things was that a contract was made in 1903 between the Admiralty and the Marconi Co., seven years before the coming of Mr. Hamilton. The Admiralty had an agreement under which they paid a sum of £5,000 a year and £20 down, for which they had the right to fit up Marconi wireless on payment for the installation. The Admiralty was aware of the importance of Marconi's wireless telegraphy in 1903, and they made an agreement which lasted for 11 years. The Admiralty had the right to provide and make their own apparatus. There was an item in the claim of £9,600 for the high power stations, and that was a claim which Mr. Hamilton said he made because the company wrongfully withdrew from the contract which they had made with the Postmaster-General with regard to the Imperial wireless chain. Under the agreement, which was made on July 19th, 1912, the sum of £60,000 was to be paid for the installation, and, in addition, a royalty was to be paid. What that would amount to it was impossible for anyone to say. It was not alleged that any stations under the agreement had been built, but it was said that they had the chance of holding the Postmaster-General to the contract, and if they had been built they would have got their money at some time.

Plaintiff said that he was, therefore, entitled to claim the £9,000 for the two stations which would have been within his area, and 10 per cent. on the gross receipts which he (plaintiff) put at £2,000 per annum for each station. Why it was put at that figure he (counsel) did not know, as there was a Treasury minute to the effect that no accurate forecast could be made of the probable receipts. There never was a contract which started upon such stormy waters as this Marconi contract. It was started on July 19th and had to be ratified by the House of Commons. A considerably controversy arose upon the money vote, and there was a long delay. On January 15th the Marconi Co. claimed to be allowed to withdraw from the contract. They said that prices had gone up, and for that and other reasons they asked to be allowed to withdraw from the contract. It was nevertheless alleged that £9,000 was due upon the price of the stations, which would have been sold had the contract been carried out. The words of the agreement were, however, that he was to receive 5 per cent. on all sales effected by the company, and these sales were not effected. After a Committee had been sitting a long time Mr. Herbert Samuel, the Postmaster-General, as he then was, on July 2nd announced that he did not intend to enforce the contract with the Marconi Co., but Mr. Hamilton wanted to say that a sale was effected nevertheless. His right to commission was only when payment was received by the company. A more favourable contract was entered into on July 30th, 1913, and ratified by the House of Commons, but in December, 1914, the Postmaster-General abandoned the whole thing and no stations had been built and no money had been paid. The whole scheme of the Imperial chain, in fact, broke down, and there was no ground for saying that any portion of the £9,600 could be payable by the defendants.

The Referee said that the reference to him was as to payments found due, but a payment upon certain things which had not happened could not be said to be due. It could not be contended that the money had been received by the company, and therefore the money could not be due.

Mr. Eustace Hills argued that the commission was due, although the money might not have been received by the principal.

On Thursday, July 15th, Mr. Pollock, resuming his speech, said in regard to the amalgamated company, in respect of which the plaintiff claimed 5 per cent. on £45,000 and £10,000, that the amalgamation was not a sale at all, but merely a rearrangement of the business. It was only the old business under a rearrangement, so that the two rival companies might be able, instead of cutting the rates, to join forces and bring into the common stock the business which had hitherto been done by the two. It did not involve any new business undertaken for the benefit of the old company.

Mr. Arthur Cappalare, the defendants' accountant, gave evidence as to the various transactions in which the plaintiff had been engaged for the Marconi Co., and produced books to show what was owing to him in respect of those transactions, particularly in relation to the shipping installations, and witnesses were called from the various shipping companies to prove that plaintiff's claim in respect of the installations was not always justified, after which the hearing was again adjourned.

On July 16th Mr. Cappalare was recalled and further examined on the accounts of the company relating to the plaintiff's work during the term of his agreement with the company, and the payments made to him in respect of that work.

The hearing was adjourned until Thursday, July 22nd.

The Electrical and Industrial Investment Co., Ltd.

In the Chancery Division, Mr. Justice Younger, on Tuesday, July 19th, sanctioned a reduction of the capital of this company, in accordance with resolutions passed by the various classes of shareholders.

Poster Stamps.—Messrs. W. T. Henley's Telegraph Works Co., Ltd., of Blomfield Street, London Wall, E.C., have issued a set of half-a-dozen large poster stamps, effectively illustrating in colour a number of their manufactures—namely, street pillars, terminal boxes, joint-box compounds, colliery boxes and service cut-outs.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

An Italian Motor Searchlight.

We have already illustrated one of the motor searchlight plants used by the French military authorities and also one of British construction supplied to our own Government. The following particulars of a similar vehicle, built by the Fiat Co., of Turin, for the Italian military authorities may also be of interest. The vehicle, which is fitted with a 35-H.P. petrol engine, is designed for a useful load of 3 tons and for a maximum speed of 20 miles per hour. The engine is so arranged that when the lorry is not travelling, it can be coupled up to a continuous-current dynamo, giving 100 amperes at 80 volts. The searchlight, which is carried on a light four-wheeled truck, has a diameter of 90 centimetres; it is so arranged that it can be quickly removed from the wagon, a length of cable carried on a couple of reels enabling the searchlight to be used at a distance of about 130 yards from the current-generating wagon. Fig. 1 illustrates the outfit.

A feature of the details of the plant is the provision of a magnetically-operated regulator, which acts upon the engine carburettor in such a way as to prevent variations in the engine speed when the current is switched on and off the searchlight. The wagon is provided with pneumatic tires, "twins" being fitted at the rear; the searchlight trolley has small wheels of the cycle type.

Circulator for Economiser.

The National Boiler and General Insurance Co., Ltd., of National Buildings, St. Mary's Parsonage, Manchester, have introduced a device for preventing the corrosion of the pipes at the inlet end of an economiser, by circulating a proportion of the hot water from the top branch pipe with the incoming cold water, thus raising the temperature of the pipes above 100° F. It consists of a gun-metal nozzle inserted in the course of the inlet from the pump, at the throat of a coned pipe connected also with the top branch pipe, and acts after the manner of an injector, as shown in the accompanying section. The nozzle can be removed at any time by taking off the bolted cover. It is stated that experiments have shown that the temperature of the feed inlet can thus be raised to 120-140° F. without causing a reduction of the temperature of the outlet water—the latter, in fact, being generally higher than before the installation of the circulator—and sweating and wasting of the pipes is prevented; there is also less tendency for soot to collect on the economiser pipes. The circulator is made in three sizes.

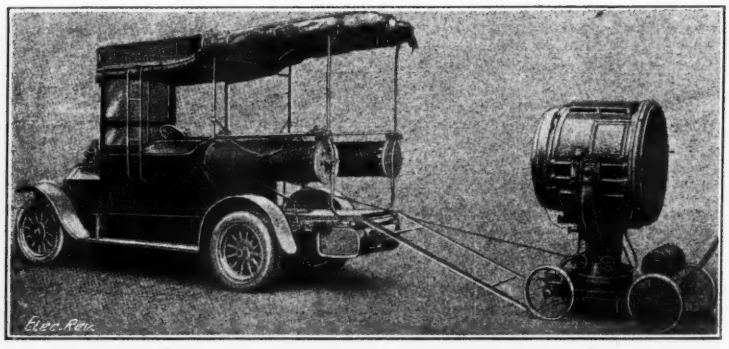


Fig. 1.—Italian Motor Searchlight Plant.

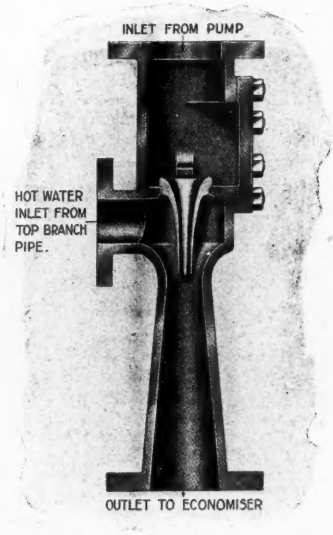


Fig. 2.—Section of Circulator.

Impermeability Tester.

The *Génie Civil* reports a note submitted to the Académie des Sciences recently by Mr. Ch. Moureu, describing an apparatus for testing the non-permeability to water of textile fabrics, especially of cloth intended for military uniforms. The device is called the "Impermeabilimeter," and consists of a glass cylinder A, fig. 4, open at both ends, graduated in depth in centimetres, and provided with a flanged brass collar, to which the sample of cloth F to be tested is secured by means of a brass ring B and bolts C. A tripod G with a stem jointed at G_1, and an insulating portion G_2, carries a gilt-brass disk H, upon which is laid a disk of thin paper I which has been soaked in a solution of potassium sulphate and dried, and waxed for a width of 1 cm. round the perimeter. Upon the paper a disk, J, of very thin wire gauze, of platinum or gilt copper, is placed, and H and J are connected to the poles of a battery with a relay R in circuit, which, when the circuit is closed, actuates the style of a recording chronograph, immediately afterwards breaking the circuit and ringing a bell.

In the case of a fabric waterproofed with india-rubber, the disk

F is placed directly on J; if rubber is not used, a space of 5 mm. is left between F and J. Distilled water is poured into the vessel A up to a known depth, the electric circuit is closed and the chronograph is started. When—if at all—the water penetrates the fabric, it moistens the paper and completes the circuit, actuating the relay. If artificial rain is to be used for the test, A is turned upside down on the table, the top of which is set on a slope by means of the joint G_1, and a jet of water from a capillary orifice is allowed to fall from a known height upon the cloth,

FIG. 3.—"VESPER" HEATING PILLAR.

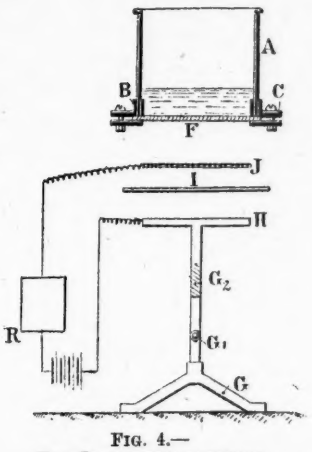


FIG. 4.—THE IMPERMEABILIMETER.

the water trickling off the latter. Penetration is announced automatically as above described. Thus, it is claimed, the waterproof qualities of cloths can be measured under standardised conditions.

"Vesper" Heating Pillar.

MESSRS. STURGE & BAKER, of Premier Works, Sheepcote Street, Birmingham, have introduced a handy substitute for the radiator lamp, by which the lamp type of radiator can be easily turned into an electric fire with red, glowing heating units.

The method consists in substituting for the lamp a "Vesper" heating pillar, which is wound with the usual wire spiral, and has two contact pins at the lower end for insertion in the socket, which takes the place of the lampholder, as shown in fig. 3.

The pillars take about 500 watts, and quartz cylinders and caps are supplied to slip over them with a view to improving their appearance. The makers suggest as a good plan to replace only part of the lamps, and thus obtain a dual heating system.

Simplified Method for Calculating Illumination.

Methods of figuring illumination are ordinarily so technical that they are not understandable by many contractors, and hence little care, other than "rule of thumb" methods, is taken with the smaller illumination problems.

The accompanying chart can be easily and quickly employed to determine the proper number of lamps to use in lighting a given

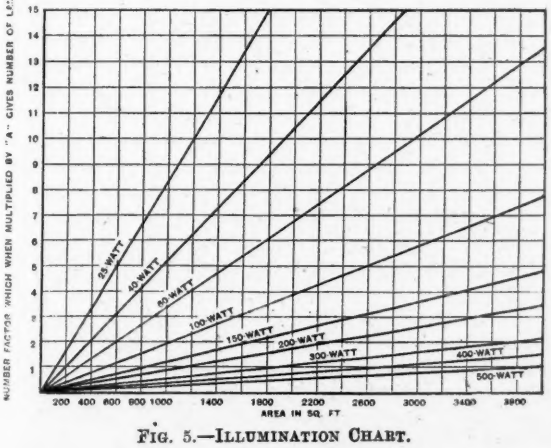


FIG. 5.—ILLUMINATION CHART.

area. When it is used in connection with the table of average intensities given below, any ordinary problem can be accurately solved. This chart and table are supplied to the canvassers of the Texas Power and Light Co., Dallas, Tex. Attention should be given to spacing units so as to secure uniform distribution. The amp size should be chosen so as to obtain as nearly as possible a number of squares, in no case less than 10 ft. on a side, one lamp being used in the centre of each square.

In order to get the best results, lamps should be hung at distances above the plane to be lighted as indicated below, D representing the distance between two lamps, which, in the case of the square arrangement, will equal the side of a square.

Type of reflector.	Height above plane.
Extensive	0·5D
Intensive	0·8D
Focusing	1·3D
Concentrating	2·0D

VALUES OF "A"—INTENSITIES IN FOOT-CANDLES RECOMMENDED FOR VARIOUS SERVICES.

Auditoriums	2·0	Residences—hall ...	0·7
Ball rooms	2·0	Reception room ...	1·0
Banks—general ...	3·0	Dining room	1·5
Banks—desks	5·0	Kitchen	2·0
Bar rooms	3·5	Bedroom	1·5
Barbers' shops... ...	4·0	Bathroom	2·0
Billiard halls—tables...	6·0	Show window... ...	20·0
Café	3·0	Stores—Clothing ...	3·0
Church	2·0	Drug	3·0
Court rooms	2·5	Grocery	3·0
Drafting room... ...	8·0	Hardware	3·0
Library—reading room	3·0	Jewellery	5·0
Offices—general ...	6·0	Shoe	3·0
Postal service	7·0	General merchandise ...	3·0
Pool tables	6·0		

—Electrical Review and W. Electrician.

BUSINESS NOTES.

Consular Notes.—FRANCE.—The American Consul at Havre, in a recent report, states that Havre maintained in 1914 its rank as the most important copper market in France. The total imports into Havre in 1914 amounted to 63,905 tons, as against 74,869 tons in 1913. The total exports were 8,352 tons in 1914, against 11,425 tons in 1913. The Havre copper market, which was established at the beginning of 1912, has developed steadily and it transacted a large import business in 1914. It is certain that the stock in the Havre warehouses would have reached a record-breaking figure if the war had not occurred to disorganise business. The local copper market, however, was able to render the country an important service by supplying the requirements of the industries engaged in manufacturing for the national defence at a time when, by reason of the difficulties arising from the war, the supply of copper for this purpose would otherwise have failed.

The Consul also reports that the Société Westinghouse, of Havre, was well provided with orders of various kinds during 1914. As regards electrical material, the most important orders related to large engines for steel mills, including the forges of Audincourt and Wendel and large generating plant for the mines at Lens, the Société de l'Acetylene, the gas works of Clermont Ferrand, &c. Numerous transformers for electro-metallurgical and other installations were constructed during the year. The electric traction department of the Havre plant was also favoured with important orders, notably for the electrical material in high power electric locomotives for use by the Midi Railway in the South of France, electric traction engines and other material for the equipment of the French State Railways.

COLOMBIA.—The American Consul at Cartagena reports that American manufacturers furnish about 57 per cent. of the total imports of electric motors, materials and pumps entering Colombia through the port of Cartagena.

The following table shows the imports of motors and parts, electrical materials, and electric pumps at the port of Cartagena during the calendar year 1914, and the principal countries of origin:—

	Motors and parts.	Electrical materials.	Electric pumps.
France	$380	$68	—
Germany	1,188	9,495	$514
United Kingdom	9,641	1,697	—
United States	19,289	12,398	157
All other countries	98	161	369
Total ..	$31,039	$23 679	$1,040

The only possible user of electro-hydraulic valves is the Cartagena Waterworks, Ltd. The electric light plant, now about 19 years old, is owned and operated by the municipality. This plant has given excellent service, but the equipment will need replacing in the near future, and the attention of American manufacturers of dynamos, boilers for wood fuel, and other equipment, is called to this prospective trade opportunity. The local telephone company is a private concern. All correspondence and printed matter should be in the Spanish language. Specifications as to measurements should be converted into the metric system. Prices may be quoted c.i.f. or f.o.b. in American currency. Inasmuch as the import duties are specific, and are levied on the gross weight, the the tare on shipments should be reduced as much as possible, and the net and gross weights should be set forth in kilos. It is suggested that in the absence of a well organised export department, it would be better to transact business through one of the

commission houses, because those houses already control a large part of the import trade, and have adequate banking facilities and accurate credit information.

In this connection it is interesting to note that the American Consul at Barranquilla reports :—

This Consulate again feels it necessary to call the attention of manufacturers and exporters to the fallacy of a policy that would require the customer in Colombia to pay commission tribute to a general agent in Buenos Ayres. This holds good with regard to Colombia, Venezuela, the Guianas, Ecuador, Peru, and the West Indies. In fact, the writer is convinced that the establishment of exclusive general agencies in any one Republic of South America with a view to doing business therefrom even with neighbouring Republics is an error. Such action reduces the house's business radius to that small district within easy reach of the exclusive general agent's local place of business. It virtually destroys any chance the house might have to do business with others of the 20 Republics of the continent. Each country feels itself sufficiently important to merit the establishment of a general agency within its own borders, or to have its field left open to do business direct with its natural trade-connection point, which, in the case of Colombia, would be New York, New Orleans, &c.

Before establishing agencies in any part of South America every house should carefully study the map of the country where the agent is to be located, and grant him the field which by natural routes and for natural reasons he can cover, and nothing more.

No New York exporter would establish a general agency at Bombay to supply tools and implements and cotton goods to Yokohama, yet the distance from Bombay to Yokohama is probably a little less than from Barranquilla to Buenos Ayres. Moreover, there are regular lines of steamers between Bombay and Yokohama.

Americans must discriminate between South America as a whole and the various Republics of South America. This is an important point in American trade propaganda and should be driven home to every merchant and manufacturer of the United States.

CHINA.—The American Consul at Canton reports that since the declaration of war in Europe there have been several electric light plants established in various cities and towns within the Canton district, and it is interesting to note that in most cases the orders for the electric end of the various plants have been sent to the United States. The orders for engines, however, were sent to England. The following is the list of orders :—

At Kingmoon, a treaty port in the Canton Delta, there has just been delivered a 75-KW. one-phase alternator complete, with suction gas plant. An order has been secured for a second 75-KW. set complete with air compressor. The value of the two orders amounts to about £3,800.

At Mengtsze, Yun-nan Province, a contract has been entered into for one 75-KW. three-phase steam-driven alternator, complete plant, valued at about £3,500.

Sainam, near the treaty port of Samshui, two 40-KW. three-phase alternators and plant, valued at about £1,800.

Tai Lang, one 40-KW. three-phase alternator and suction gas plant, valued at about £800.

Shek Loing, a large town on the Canton Koulom Railway, one 40-KW. three-phase alternator and suction gas plant, valued at about £800.

Chan Tsuen, one 30-KW. three-phase alternator and suction gas plant, valued at about £650.

Nanning, the capital of the Kwangsi Province, one 75-KW. and two 40-KW. three-phase alternators and switchboard complete, valued at about £1,200.

Dissolution.—BIRCH & HARRIS, cycle manufacturers and electrical engineers, Nuneaton.—Messrs. E. H. Birch and J. Harris have dissolved partnership. Mr. Birch will attend to debts and continue the business.

Grand Trunk Railway.—Those interested in and familiar with Canada are aware of the important part of the great railways of that country play in its colonisation and development, and they will no doubt be more than interested in the cable news just to hand from the Canadian headquarters of the Grand Trunk railway system to the effect that commencing Tuesday, July 13th, an up-to-date through passenger service—Toronto to Winnipeg and Winnipeg to Toronto *via* Cochrane and the new Trans-Continental route, operating thrice weekly, has been inaugurated. This new service will consist of the latest designs in standard and tourist sleepers, dining car coaches and colonist cars. Besides the important fact that this now affords the G.T. Railway an unbroken service from the Atlantic to Prince Rupert on the Pacific Coast with steamship connection to Vancouver and Victoria, B.C., Seattle and California points, U.S.A., through all the well-known commercial and tourist centres, including the finest scenery in the Canadian Rockies, it is opening up to the settler and tourist new fields rich in agricultural, mineral and scenic wealth. It is anticipated that this latest development will strongly appeal to visitors to Canada from Great Britain.

Catalogues and Lists. — CRYPTO ELECTRICAL CO., Acton Lane, Willesden, N.W.—Twenty-two-page illustrated catalogue containing some general notes regarding their alternating-current motors, and tabulated horse-powers, speeds, prices, weights, &c., of single, two and three-phase motors for various periods, also prices of no-volt and overload releases, speed reduction gear, and polishing motors. The smallest motor included is a ⅛ H.P. and the largest 25 H.P. A table gives information relating to the power required to drive various classes of machinery.

MESSRS. STURGE & BAKER, Premier Works, Sheepcote Street, Birmingham.—Illustrated and priced leaflets relating to cord absorbers; "Vesper" pillars and sockets for electric fires; "trolley lights" (domestic and factory patterns of fittings with swinging arms and extensible devices); and "Premier" switches.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., Ponder's End.—A new illustrated postcard has been prepared, copies of which are being supplied, over-printed, to their customers. The design shows a Royal Ediswan drawn-wire lamp, and suggests its use as an aid to economy in keeping the "Bills" down, the "Bills" in this particular case being the Supreme War Lord and his devoted son, the Clown Prince.

GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—Bulletin No. 10 (36 pages) containing a detailed description, excellently illustrated, of the condenser system of protection against surges.

Book Notices.—*The A.B.C. of Electricity.* By W. H. Meadowcroft. New York : Harper & Brothers. Price 2s.—This book, which is written in the "popular" style (many of the paragraphs beginning with "Now," or "Well") has been enlarged and reset. It makes no pretentious claims, and is couched in simple language; as it is now in its third edition, it evidently fills a want.

"*Proceedings* of the Rugby Engineering Society, 1913-14." Vol. XI. Rugby : The Society. Price 10s. 6d.

"*Bulletin* de la Société Internationale des Electriciens." Vol. V, No. 43. June, 1915. Paris : Gauthier-Villars. Price 3 fr.

"*The Beama Journal.*" July. No. 3. London : British Electrical and Allied Manufacturers' Association. Price 1s.

National Physical Laboratory Collected Researches. Vol. XII. 1915. London : Harrison & Sons. Price 12s.

"The Manual of Electrical Undertakings and Directory of Officials, 1915-16." By E. Garcke. Vol. XIX. Electrical Press, Ltd. Price 21s. net.

Trade Announcement.—MESSRS. HANDLEY & ROBINSON, LTD., of Dublin, have opened another branch office at 42, Great Charles Street, Birmingham, for the purpose of extending their electrical contracting business, and they will be pleased to receive price lists and catalogues from manufacturers.

Bankruptcy Proceedings.—JOHN BOULT & JOHN HUGH BOLT (trading together in co-partnership under the style or firm of John Boult), electricians, 3, Grosvenor Street, Chester.—The first meeting of creditors was held at Chester on July 14th, when the statement of affairs showed liabilities amounting to £603, and assets valued at £578, the estate disclosing a deficiency of £25. The failure of the debtors was due to insufficient capital, costs of actions taken against the firm, and the effects of the war upon the cash sales. The separate estate of John Boult disclosed liabilities of £1,487 and assets of £801. It was decided to appoint Mr. Parkin S. Booth, accountant, 2, Bixteth Street, Liverpool, trustee.

VERNON GEO. COBB, electrical engineer (trading as Longdon and Cobb), Nottingham.—Application for debtor's discharge to be heard August 19th, at Nottingham.

LIGHTING and POWER NOTES.

Argentina.—The Compania Transatlantica de Electricidad recently applied to the Municipality of Buenos Ayres for authorisation to extend its services to suburban districts where population is relatively scarce, by means of overhead cables, as the installation of subterranean cables would be too expensive to be justified by the revenue therefrom. The Itendencia has now issued a decree conceding the authorisation asked for with a stipulation that when the consumption exceeds a specified quantity, the overhead cables shall be replaced by underground ones.

The correspondent of *La Nacion* at Lincoln (Buenos Ayres) says : "A contract is about to be signed between the municipal authorities of this district and an important German firm in the Federal Capital whereby the latter take over the lease of the electric light and power, and water supply services belonging to the former. The completion of this arrangement would imply the rescission of the contracts now existing between the municipality and the company at present exploiting these services."—*Review of the River Plate.*

Australia.—A company has been formed to supply Toora and Foster (Victoria) with electric current generated by water power.—*Tenders.*

Aylesbury.—The U.D.C. has decided to adopt the following arrangement for supply to showroom premises :—That each consumer be charged 100 units per annum at 6d. per unit, to be paid quarterly, winter 30 units per quarter, and summer 20, after which consumption is to be charged for on the power sliding scale. The Market Theatre Co. is to be supplied at a flat rate of 3d. per unit.

Barnes.—ELECTRIC COOKING.—Following his report in February last, the electrical engineer has submitted an additional report on the question of installing electric cookers in certain property belonging to the Council. He recommends installing, to commence with, 12 cookers, costing £4 each, and estimates the average consumption of energy per cooker at 624 units per annum, taking 18 units a week in the summer and 6 units a week in the winter. An extra charge of ¼d. per unit would, on this basis, return 13s. per annum, which would cover interest, redemption and maintenance. These figures have been obtained from observation with two experimental cookers. It is, therefore, proposed to charge 1d. per unit, being ¼d. for the Public Health Committee to cover its outlay, and ¾d. for the supply of energy including metering. The Gas Co.'s charges are a connecting fee of 10s., plus 1s. 6d. a quarter meter rent and 6d. a quarter stove rent, with gas at 2s. 4d. per 1,000 cb. ft. The Public Health Committee recommended that the proposed scheme be carried out.

Barnsley.—L.G.B. INQUIRY.—The Corporation has decided to proceed, if permission be granted, with part of the electricity extension scheme, and a L.G.B. inquiry was held last week into an application for power to borrow £21,850.

In response to communications from the Home Office and military authorities, the Corporation has resolved to suspend public lighting of the streets except on Saturday evenings, and the area to be lighted, &c., is left to the discretion of the chairman of the Electricity and Lighting Committee.

Bath.—PRICE INCREASE.—The E.L. Committee of the T.C. has recommended that the price of current be advanced to 5½d. per unit as from September 29th, an increase of 10 per cent.

Bury St. Edmunds.—YEAR'S WORKING.—According to the *East Anglian Times*, for the past year the electricity department's working cost, including £800 for new plant, amounted to £4,138; interest amounted to £1,039, and sinking fund to £975, making a total of £6,152. Some 404,000 units were sold representing £5,679. Due to exceptional causes the works costs were heavier than previously; 75 motors of 420 H.P. are now connected to the supply, and it is reported that the experimental free wiring scheme, under which current is supplied at 6d. per unit through prepayment meters, has been very well received and some 40 applications are now in hand.

Continental.—RUSSIA.—The "Petrograd Waterfall Power Distributing Co." has petitioned the Veaborg Government for permission to construct the necessary works at the Rouchial Waterfall, which the company desires to exploit. It is intended to construct the barrage and works on land belonging to the company at the Korvankosky Waterfall, about 3 km. further down than the Rouchial Falls. According to the Finland Hydrographical Bureau 1,200 cb. metres of water per second pass Vdobea, and it is contemplated to install nine groups of machines, each of 10,000 H.P. The total power to be generated by the station is estimated at 80,000 H.P.

ITALY.—An important hydroelectric scheme, which has been under consideration since the year 1900, has just received Government authorisation. It consists in linking the international station at the Simplon Tunnel with Lake Maggiore by means of a navigable canal utilising a part of the navigable course of the River Toce. It will provide hydraulic power equal to from 7 to 15,000 KW. for the generation of electricity, and its cost is estimated at 7,771,770 lire. The canal consists of four sections, fed from the Toce by as many intakes, and involving the creation of a number of falls of varying power, each capable of being used for the generation of electricity.—*Rivista Técnica d'Elettricità.*

Darwen.—YEAR'S WORKING.—At the beginning of the year there was a balance of net profit of £1,191 on the electricity undertaking, of which £500 was transferred to the rates; the result of last year's working showed a net profit of £279, and the disposable balance to carry forward was therefore £970. No contribution is to be made in aid of the rates during the current year, owing to the necessity of raising the working balance of the department. Since the commencement of the works in 1899, £3,270 has been contributed to the rates, and £1,991 received from the rates. The units generated during the past year totalled 2,484,297; private consumers took 1,566,053, and tramways and public lighting accounted for 576,960. The cost of generating averaged '59d. per unit, against '60d. in the previous year.

Glass Houghton.—E.L. SUPPLY.—The Pontefract R.D.C. has decided to raise no objection to the proposal of the Yorkshire Electric Power Co. to lay cables in the principal roads and in Carr Lane.

Holmfirth.—SCHOOL LIGHTING.—The Education Committee has decided to request the West Riding County Council to provide electric lighting at the Holmfirth School; during the discussion by the Committee, a member stated that no end of trouble and accidents had attended the present system of gas lighting, and it was thought that public buildings should be lighted by electricity as an example to the public.

Hurst.—PROPOSED E.L.—The D.C. has been asked by the Ashton Corporation if it would be prepared to consider the question of taking a supply of electricity in bulk from the Corporation for the use of persons in the Hurst district.

Hythe (Kent).—ELECTRIC PUMPING.—The T.C. has accepted the offer of the Folkestone Electricity Supply Co. to pump water at the Saltwood reservoir at 3d. per 1,000 gallons, provided a temporary plant is installed to see if the well will yield 40,000 gallons per day, the Council to pay the expense if that quantity is not produced.

India.—The Sigua (Jherria) Electric Supply Co. is the name of a new undertaking which has lately been formed in Calcutta, with a capital of 1,200,000 rupees.

Kilkeel (Co. Down).—STREET LIGHTING.—An agreement between the District Council and the Irish Towns Electric Light and Power Co., for the lighting of streets and roads, provides for the erection and maintenance of 60 lamps at an annual rent of £65 15s., which involves a rate of 4d. in the £ on the area of charge.

King's Lynn.—PRICE INCREASE.—The T.C. has decided, owing to the increased cost of fuel, &c., to raise the price of current for lighting from 4d. to 4½d. per unit, and the charges for power by 5 per cent. all round.

London.—ST. PANCRAS.—As a result of further consideration of the question of deferring boiler extensions at the King's Road station, the Electricity Committee recommends the B.C. to agree to the installation of two of the four proposed boilers and the carrying out of certain necessary constructural work, at a cost of £24,265, thus deferring some £25,000 expenditure, being the additional amount required to complete the scheme.

The accounts of the electricity undertaking for the year ended March last show that 10,649,000 units were sold, as against 11,100,000 in the previous year. The revenue amounted to £87,052 as compared with £93,483; and the net profit to £6,620, as against £12,413 in the previous year.

SHOREDITCH.—The B.C. has been recommended, at the request of the L.C.C., to limit the expenditure under the order sanctioning the borrowing of £500 for the purchase of electricity meters, during the duration of the war, to the provision of meters for consumers doing work for the Government.

New Zealand.—The Te Kuiti electric light duplication scheme is to be commenced shortly, the cost is estimated at £4,000. —*Tenders.*

Portsmouth.—YEAR'S WORKING.—The accounts of the electricity undertaking for the year ended March last show that 3,779,600 units were sold, the total revenue, £51,608, being less than that of the previous year. The total working costs, including some £600 for grants to employés with the Forces, were only £100 in excess of those of 1913-14, but due to the falling off in revenue, the net balance on the year's working was only £386, as compared with £3,342 in the previous year. The department possesses an insurance fund of £7,052, and a reserve fund balance of £30,724.

Stamford.—PRICE INCREASE.—The Urban Electricity Supply Co. has informed the B. of G. that, owing to the increase in the cost of production, the price of current for all purposes had been advanced 10 per cent. as from July 1st.

Stratford-on-Avon.—The T.C. has decided not to allow the Electricity Co. to vary the terms of the agreements for the supply of current entered into with the company. The application was for an increased price per unit to be charged.

Swansea.—PROPOSED SHOWROOM.—The E.L. Committee proposes to establish a showroom in Wind Street in connection with the electricity undertaking.

Swinton and Pendlebury.—The U.D.C. has given permission, under the agreement which exists between the Council and the Lancs. E.P. Co., for the company to supply electricity for power purposes to Bridgewater Mill, Pendlebury. Extensions to the electrical equipment of Messrs. Matthews & Yates's works are in contemplation.

Tasmania.—The Hydro-electric Power and Metallurgical Co., Ltd., is entering into a contract with the Tasmanian Government for a bulk supply of power for use in its proposed works. The initial quantity of power required will be 3,500 H.P.—*Tenders.*

Thornley (Durham).—The Weardale Coal and Iron Co. has offered a reduction of 25 per cent. of the total amount of the account for electric lighting, and the Parish Council has agreed to accept this offer.

Walkden.—Two electric pumps installed in the "Seven Feet" mine at the Ellesmere Colliery, Walkden, to work alternately, are capable of lifting to a considerable height 1,100 and 900 gallons per minute, and in consequence of their use it has been decided to dispense with the old Roughfield pumping pit, a quarter of a mile away.

West Yorks.—PROV. ORDER.—In regard to the decision of the Electrical Distribution of Yorks., Ltd., to apply for powers for lighting in different areas of the West Riding, the Featherstone U.D.C. and the Penistone U.D.C. have decided to interview the company's engineer, and the Rawdon D.C. has decided to deal with the matter in Committee. The Midgley D.C. has declined to agree to the company's proposal.

Wetherby.—PROV. ORDER.—The R.D.C. has decided to make application for a provisional order to enable the Council to provide electric lighting at Boston Spa.

Winchester.—YEAR'S WORKING.—For the year ended March 31st last, 955,622 units were sold, as compared with 739,529 in the previous year. The maximum load was 639 KW., and the connected load 2,294 KW., of which 1,506 KW. was lighting. The coal used per unit sold amounted to 5·12 lb., costing ·415d., and the total working costs were 1½d. per unit. The gross revenue for the year was £14,649; the gross profit £6,601, and after meeting interest and sinking fund charges, and sundry charges (£269) the net surplus was £1,317, as against £404 in the previous year. During the year power and heating units increased by over 50 per cent., and heating cooking connections at March totalled 410 KW.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—The rather complicated ticket system on the cars between Ashton and Hurst has been abolished, and an agreement has been arrived at between the two authorities whereby all receipts on the Hurst section up to £3,600 per annum will be divided as follows:—Ashton 62 per cent., Hurst 38 per cent., with an equal division of all receipts over £3,600.

Australia.—It has been officially announced that the electrification of the Melbourne suburban railways is still being blocked by delays in delivery of equipment, and a further delay of six months is now announced; the probable date for commencing to run the first electrified section is given as December, 1916. This is the Sandringham to Essenden line, after which the Melbourne to Williamstown line, including the racecourse, will be dealt with.

The latest report on transport and communication issued by the Commonwealth statistician shows that the total length of electric tramways line in Australia open for traffic at June 30th, 1914, was 357½ route-miles, of which 145½ miles are in New South Wales and 62 miles in Victoria. The capital cost amounted to £10,544 235, excluding the North Melbourne tramway and 34½ miles in Queensland.—*Tenders.*

Blackpool.—Year's Working.—The annual report of Mr. Charles Furness, the general manager, on the working of the Corporation tramways shows that the department has been hard hit by the war. The gross profit was £31,255, a drop of £10,000 compared with the previous year, and the net profit fell off by a similar amount. However, £12,000 was given to the rates, and the balance of £1,736 placed to reserve. The passengers carried, 13,624,000, were some 665,000 less, while the car-miles run increased by 9,700. The report draws attention to the rapid increase in the number of contract ticket-holders, who now number 1,466, bringing in £4,146 in revenue. Mr. Furness points out that these passengers are being carried for less than the average operating expense per passenger ('79d.), and, in fact, that they are being subsidised to the extent of ¼d. per journey. A recent census showed that contract journeys were one-fifth of the total. It is noteworthy that the promenade route contributes 45 per cent. of the revenue, which last year reached 16·65d. per car-mile. The department has a reserve fund of £4,401, and a permanent way renewal fund of £14,381; its total allocations since 1896 have reached £16.810 to reserve, £56,161 to permanent way and other renewals, and, in addition, £77,497 to the rates.

Continental.—Russia.—Extensive public works are in course of execution in Perm, including the construction of tramways, the length of which will be 16 versts—10½ miles; the electrical station is being extended correspondingly. All large public concerns will belong to the town, and no concessions are being granted; deficits are quite expected in the operations of the first one or two years. The money, 3½ million roubles, was raised in England, but owing to increased cost of materials and labour since the estimates were made, a further loan of 1 to 1½ million roubles will have to be issued.

Darwen.—Year's Working.—The result of the year's working of the Corporation tramways was a loss of £729—£172 on the Darwen section, and £557 on the Hoddlesden section. The total car-mileage was 267,670, an increase of 758; and the decrease in fares amounted to £987. On the Darwen section the receipts averaged 14·2d. per mile, the total working expenses were 10·8d., the interest and sinking fund charges 3·6d., and the resulting loss was ·17d. per mile run. On the Hoddlesden section the receipts were 12·5d. per mile, working expenses 11·3d., interest and sinking fund charges 4·9d., and the loss 3·67d. per mile.

London.—L.C.C.—The award of the Conciliation Board, which has been considering the demands of the tramway employés, is adverse to the men on practically all points, except the war bonus of 3s. a week, which it is proposed to extend to men earning 40s. a week and under. About a third of the men object to the award, and it is proposed to take a ballot with a view to the matter going to arbitration. The Finance Committee considers that the effect of the award will be to increase the deficiency on the working of the Council's tramways to such an extent that the general reserve fund will not be able to meet it.

Rawtenstall.—It has been decided that £400 from the renewal and reserve funds of the tramways undertaking, and £1,500 from the renewal and reserve funds of the electricity undertaking be invested in the war loan.

Swanscombe.—The P.C. has decided not to consent to the application of the Dartford and District Tramways Co. for an extension of time for constructing the tramways in the parish.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—August 25th. Dry cells, earth clips, recording counters, and various other instruments and apparatus, for the P.M.G. See "Official Notices" July 9th.

September 1st. Condensers, testing sets, rheostats, Morse sounders, and Wheatstone transmitters, for the P.M.G.* See "Official Notices" to-day.

Perth.—August 11th. Measuring instruments, for the P.M.G. See "Official Notices" July 16th.

August 25th. P.M.G. One ton of crushed salammoniac, and 1½ tons of steel galvanised wire. See "Official Notices" to-day.

Sydney.—September 13th. Council. A.C. and D.C. electric motors. Specification (10s. 6d.) from E.L. Department, Town Hall.*

September 6th. Metropolitan Board of Water Supply and Sewerage. Centrifugal pumps and electric motors at Richmond pumping station.* Acting Secretary, 341, Pitt Street, Sydney.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

Aylesbury.—July 28th. Electric motor and pump capable of lifting 5,000 gallons of sewage per hour, with lift 19 ft. 3 in., &c., for the U.D.C. Mr. W. H. Taylor, Engineer and Surveyor, Town Hall.

Bradford.—Electric lighting of five through houses and workrooms adjoining, in Arncliffe Terrace and Woodhead Road, now in course of erection. Specifications, &c., may be seen on the works on application to Mr. T. P. Cowling. Tenders to be delivered to 93, Horton Road, Bradford.

Bristol.—August 23rd. Corporation. One 6,000-kw. three-phase steam turbo-alternator with condensing plant. See "Official Notices" to-day.

Dublin.—July 26th. Corporation. High and low-pressure cables and accessories, transformers, transformer pillars and electricity meters. See "Official Notices" July 16th.

Guildford.—Motor-driven fan, for the Guildford Electricity Supply Co. See "Official Notices" to-day.

Leith.—July 26th. Corporation. Twelve or six months' supply of washed pearls (9,000 or 6,000 tons) for the Electricity Department. Specifications from the Burgh Electrical Engineer.

London.—L.C.C.—Tenders are to be invited for installation of electric light at the new West Norwood fire station.

Middleton.—August 10th. Corporation. Coal for the electricity works. Particulars from Mr. S. Pauls, Electrical Engineer.

Morecambe.—July 24th. Corporation Electricity Department. 2,000 tons of coal or slack. See "Official Notices" July 2nd.

Rotherham.—July 24th. Corporation. 10,000 tons smudge and pea nuts; single vulcanised bitumen-covered cable, H.T. cable, rubber-insulated cable, trolley wire; ampere-hour meters. See "Official Notices" July 16th.

Salford.—July 26th. Corporation Electricity Department. Steam piping and separator, and cast-iron water piping. Borough Electrical Engineer, Frederick Road, Pendleton.

Sheffield.—July 30th. Water service conduit screen chamber, penstocks, valves, piping, &c., for the Electric Supply Committee. Mr. S. E. Fedden, General Manager and Engineer.

South Africa.—Beaufort West (Cape).—September 14th. Municipality. Suction gas engines, dynamo, booster, switchboard, battery, &c.; also poles, copper wire, insulators, street lamps, service connections, meters, &c. Specifications, on deposit of five guineas (returnable), from Mr. Chas. G. Trevett, A.M.I.E.E., 70, Fletcher's Chambers, Cape Town. Tenders to Town Clerk, Beaufort West.

CLOSED.

Australia.—The following contracts have been placed:—

Victorian (State) Coal Mine.—
H.D. bare copper wire, 7/14, 7/16, 7/18; £41, £27 and £15 per mile.—B.I. and Helsby Cables.
Shire of Dembools (Vic.).—
52-B.H.P. gas engine, suction gas plant, &c., £958.—R. Hornsby & Sons.
Generator booster spares, fuses, and testing sets, £326.—Edison & Swan U.E.L. Co., Ltd.
Battery (D.P.), £717.—T. K. Steanes.
Switchboard and erection of power-house equipment, £247.—Edison and Swan U.E.L. Co., Ltd.
Poles and outside equipment, £350.—M. W. Clements.
Aluminium cables, £272.—W. G. Watson & Co. —*Tenders.*

Ashton-under-Lyne.—The Electricity Committee has accepted the tender of Mr. B. Evans for 1,000 tons of Kiveton Park slack coal. The Market Lighting, &c., Committee has accepted the Lancashire Electrical Engineering Co.'s tender for substituting half-watt lamps for the remaining arc lamps in the market.

Barnsley.—The Guardians have accepted the tender of Messrs. Henry R. Levenson & Co., of Leeds, for the wiring for electric lighting of the able-bodied men's block and the workhouse workshop for £12, the infants' bungalow at £7 10s., and the nurses' home at £22.

Chesterfield.—The T.C. has provisionally accepted the tender of the Brush Electrical Engineering Co., Ltd., for a transformer, at £266; and that of the British Westinghouse Co., Ltd., for switchgear extensions, at £500.

Doncaster.—The Corporation has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a new water-tube boiler for the electricity works.

Heywood.—The Town Council has sealed the following contracts:—

D.C. switchboard at the electricity works.—Bertram Thomas.
600-KW. booster rotary, &c.—B.W. Electric & Manufacturing Co., Ltd.
Reversible battery booster.—Phœnix Dynamo Mfg. Co., Ltd.
Overhead single E.H.T. line.—B.I. & Helsby Cables, Ltd.
Temporary building at the electricity works.—Blakeley & Wild.

Government Contracts.—List of new contracts for June, 1915:—

WAR OFFICE.

Cables and wire.—B.I. & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connolly Bros., Ltd.; Craigpark Electric Cable Co., Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph & I.R. Works, Ltd.; Johnson and Phillips, Ltd.; Johnson, Matthey & Co., Ltd.; Liverpool Electric Cable Co., Ltd.; Macintosh Cable Co., Ltd.; Midland Electric Wire Co., Ltd.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.; Ward & Goldstone, Ltd.; Western Electric Co., Ltd.
Conduits and fittings.—General Electric Co., Ltd.
Motor-converters.—Bruce Peebles & Co., Ltd.
Electric lamps.—Edison & Swan U.E.L. Co., Ltd.; Eli Griffiths & Sons; A. Lyons & Wrench, Ltd.
Electric motors.—Elec. Construction Co., Ltd.
Works services.—Batteries at Scott's House and Whitley Bay: Siemens Bros. & Co., Ltd. Electric generating set, Didcot: Drake & Gorham, Ltd. Electric lighting, Ford House, Devonport: Corse & Co.

INDIA OFFICE STORE DEPARTMENT.

Wireless apparatus.—Marconi Wireless Telegraph Co.
Dynamos.—Lancashire Dynamo Co.
Morse keys.—Siemens Bros. & Co.
Lighting spares.—J. Stone & Co.
Standards.—Siemens Bros. & Co.
Telephone sets.—General Electric Co.

CROWN AGENTS FOR THE COLONIES.

Telegraph apparatus.—Marconi Wireless Telegraph Co., Ltd.

POST OFFICE.

Telegraphic apparatus.—I.R., G P. & Telegraph Works Co., Ltd.
Telephonic apparatus.—Western Electric Co., Ltd.
Submarine cable.—Siemens Bros. & Co., Ltd.; Telegraph Construction and Maintenance Co., Ltd.
Telephone cable.—W. T. Henley's Telegraph Works Co., Ltd.; I.R., G.P. and Telegraph Works Co., Ltd.; New Gutta-Percha Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.; B.I. & Helsby Cables, Ltd.
Dry cells.—Siemens Bros. & Co., Ltd.
Copper wire.—T. Bolton & Sons; B.I. & Helsby Cables, Ltd.; Elliott's Metal Co.; Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).
Copper wire, covered.—London Electric Wire Co. & Smiths, Ltd.
Laying ducts.—City & South London Railway diversion, Southwark section: J. A. Ewart, Ltd.
Laying ducts and pipes.—City & South London Railway diversion, City section: J. A. Ewart, Ltd.
Lifts.—Superintending Engineer's headquarters, Denman Street: Waygood-Otis, Ltd.
Modification of existing "A" and "B" positions at Dublin Telephone Exchange.—Western Electric Co., Ltd.

H.M. OFFICE OF WORKS.

Supply of switchboard fire extinguishers to March 31st, 1918.—British Fire Appliances Co., Ltd.

Ledbury.—The B. of G. has accepted the tender of Messrs. F. C. Swift & Co. for the installation of electric bells at the vagrant wards.

London.—L.C.C.—The Highways Committee reports that arrangements have been made for only one of the two 8 000-KW. turbo-generators required for the Greenwich generating station to be constructed at the present moment. The Council is to retain the option, up to six months after the termination of the war, of ordering the second machine at the price included in the company's tender adjusted to correspond with any increase or decrease in the cost of materials and labour prevailing at the time of ordering the machine, compared with the cost of materials and labour prevailing at the date of the tender.

In view of the exceptional circumstances prevailing, the Committee has authorised the purchase, for use at the Greenwich generating station, of coal as and when it can be obtained. Under this authority about 16,223 tons of coal have been purchased under contract, at a cost of about £14.980, and about 15.295 tons out of contract, at a cost of approximately £21,120, during the quarter ended June 30th, 1915.

BETHNAL GREEN.—The Electricity Committee has accepted the following tenders:—

Meters.—British Westinghouse Co.
Demand indicators.—Reason Manufacturing Co.
Time switches.—Venner & Co.

None of the firms invited to tender for house-service fuses replied, and the matter was deferred, as it may be arranged through the Stepney B.C.

Merthyr Tydfil.—The T.C. has accepted the tender of Messrs. Lucy & Co., Ltd., for 90 brackets for electric lamps at Dowlais, at 17s. 6d. each.

Oldham.—The Tramways Committee recommends the purchase of a Ford motor-van for the parcels delivery department.

Plymouth.—The T.C. has accepted the tender of Messrs. Cory Bros. & Co., Ltd., for 13,500 tons of coal for the electricity works, at £1 9s. 6d. per ton.

Sunderland.—The T.C. has accepted the following tenders:—

B.I. & Helsby Cables, Ltd.—House-service boxes, box compound.
Dussek Bitumen Co.—Box compound.
Steel & Co.—Cable ducts.
British Westinghouse Co., Ltd.—Instruments and switchgear for booster panel.
British Thomson-Houston Co., Ltd.—Reactance coils for traction motor-generator.
B.I. & Helsby Cables, Ltd., and Callender's Cable and Construction Co., Ltd.—Cable.
T. Bolton & Sons, Ltd.—Copper strip.

Tasmania.—The following contracts have been accepted:

Wynyard electric lighting.—
Suction gas plant, £1,064.—R. Hornsby & Sons.
Electrical plant and power house, £1,940.—Sutherland & Ashman.
Copper cables and line equipment, £453.—B.I. & Helsby Cables.
Insulators and fuses, £263.—Grant & Vincent.
Line erection work, £355.—Sutherland & Ashman.

NOTES.

The Electric Light.—In the course of a paper read at Chicago, Mr. S. E. Doane stated that the incandescent lamp as a current-consuming device must be accorded a high place, for probably there were 150,000,000 in service in the United States, which in the course of a year consumed more than 5,000,000,000 KW.-hours. The 25, 40 and 60-watt tungsten lamps were now operating at 1·05, 1·03 and 1·00 w.p.c. respectively, compared with 1·23 w.p.c. five years ago for the 40 and 60-watt, and 1·31 w.p.c. for the 25-watt, and were giving the same useful life as before. This improvement in efficiency had been made possible principally through the adoption of drawn-wire filaments, modifications of the structure supporting the filament, and the introduction of various chemicals within the bulb, which had allowed the operating temperature to be increased without increasing the rate of candle-power depreciation. Their mechanical strength had also been increased and their prices greatly reduced. The 40-watt lamp had come down from 90 c. in 1909 to 30 c. in 1914. The increase in efficiency of about 20 per cent. had done as much to decrease the cost of light to the consumer as the reduction in lamp price from 90 c to 30 c.

Field Telephones.—At the Royal Society of Arts, John Street, Adelphi, W.C., on Wednesday next (July 28th) at 4.30 o'clock, a special war lecture on "Field Telephones," with experimental illustrations, will be delivered by Mr. C. R. Darling, A.R.C.Sc.I., F.I.C.

Appointments Vacant.—Charge engineer and switchboard attendant (40s. and 25s.), for Gloucester electricity department; shift engineer for Stretford (40s.); junior charge engineer for York (£91); see our advertisement pages to-day.

Volunteer Notes. — ENGINEERING INSTITUTIONS' VOLUNTEER TRAINING CORPS.

Drill Centre.—By kind permission of Lieut.-Colonel A. E. Le Rossignol, head-quarters of London Electrical Engineers, 46, Regency Street, London, S.W.

Company Orders.—By Lieut.-Colonel C. B. Clay, V.D., Commandant, for week ending July 31st, 1915:—Monday, Wednesday, and Friday, Drills, 6 30 and 7.30.

APPLICATIONS FOR ENROLMENT.—All applications for enrolment should be sent to the Commandant, Marconi House, Strand, from whom all particulars can be obtained.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, July 22nd, 1915:—

Week-end Parades.—Saturday.—The Battalion will parade at Baker Street Station at 2.30 p.m., and proceed by train to Wembley Park. Detailed instructions will be issued to the Officer Commanding on that day.

Sunday.—Inspection of the Central London Regiment (Volunteers) by Brigadier-General Bridgman, in Regent's Park. The Battalion will fall in on the Green, N.E. of York Gate, Regent's Park, at 2.30 p.m. sharp. Recruits and men told off to keep Ground, &c., will parade under Company Sergeant-Major Brettargh at 2.25 p.m., at Cumberland Gate, Regent's Park. *Dress*—(except in the case of Recruits who have no uniform)—Drill Order with rifles and sidearms, but without haversacks and pouches.

There will be no Parades at Wembley Camp on Sunday.

Musketry.—Bisley.—The Musketry Staff will receive names of men who have not previously shot their course at Bisley, and who wish to shoot on Saturday next, the 24th inst. These men should report themselves to Sergeant Cotter at the Barrier of No. 9 Platform, Waterloo Station, not later than 12 55 p.m.

ACTON RANGE.—"B" Company will shoot at Acton on Saturday next, the 24th inst.

First Team to parade at 10 a.m. at Acton.

Second Team to parade at 2.30 p.m. at Acton.

Men to be in uniform and to produce their efficiency badges on the Range, otherwise they will not be permitted to shoot.

Brassards.—Members are warned that those who have not yet obtained their Brassards must do so before Sunday's Parade. They can obtain them either by personal application to Headquarters, or by sending a stamped-addressed envelope to Headquarters.

A. G. JOINER, *Captain and Adjutant.*

Fibrox.—At the annual meeting of the American Electrochemical Society a new heat-insulating material called "fibrox" was described by Dr. E. Weintraub, of the General Electric Co., of Lynn, Mass. This materal has chemically the constitution of silicon oxycarbide, and its most remarkable feature is its fibrous structure. The diameter of the fibres is of the order of 0·6 micron to 0·3 micron. That is much smaller than the diameter of thin hair. Fibrox is a soft, resilient fibrous material, and can be cut into plates, sheets and rings which are self-supporting. The apparent density of the material, while varying with the circumstances, is usually between 0·0025 and 0·0030. In other words, it weighs only from about 2·5 grammes to 3 grammes per litre. As it consists of from 99·5 to 99·9 per cent. of air (in the pores) and only from 0·5 to 0·1 per cent. of solid material, it is the very best heat insulator known, and in view of this it is very peculiar that it is a relatively good electrical conductor with a conductivity comparable to that of electrolytic solutions.

Indian Notes.—Our special correspondent in India writes:—

Jammu, Kashmir.—This enterprising city—the second in Kashmir—is very actively engaged in improving its electrical power plant. It boasts of a fair sized hydroelectric installation, which, however, is a dwarf in comparison with the hydro-installation at Baramulla, which supplies the capital city, Srinagar, with light and power, and which, in addition, supplies power for a very elaborate and powerful dredging plant for the river. The Jammu plant supplies current for the city lighting and for the Maharaga's palaces, and a further scheme is under contemplation—in fact, the specifications have been sent out—for an increase of the electric pumping plant. The electrical system in Jammu is controlled by a very capable and energetic engineer, who knows what he wants and sees that he gets it.

Jubbulpore.—The electrical inspector to Government, Mr. Mersh, is in the market for an electric installation for the New Arts College, Jubbulpore. He specifies Tudor accumulators, and either Robey, Hornsby, or Blackstone crude oil engines, and leaves the other items open to any reliable make which will comply with his specification. This habit of specifying a particular make of machine, whether engine, dynamo, or battery, is growing among Government engineers in India, and has its obvious disadvantages. It should be sufficient to issue a binding specification and ask only contractors of repute to quote, and then insist that whoever eventually gets the order should scrupulously comply with the conditions, and then there would be no cause of complaint subsequently. As things are, there is a good deal of complaining going on over irregularities, such as are referred to above.

Madras.—The Government of Madras has obtained the loan of the services of Mr. Meares, the electrical adviser to Imperial Government, to advise on several hydroelectric schemes which are under consideration. One is for Ootacamund, the summer capital of Madras. This scheme was prepared by Messrs. Walker & Co., of Colombo, for the Ootacamund municipality, and proposes a method of obtaining power from the Kemdah River, nine miles from Ooty. A much more comprehensive scheme is that proposed for supplying electrical energy to Ootacamund, Coonoor, and Wellington from the Pykira Falls. Rough estimates have also been worked out for what is known as the Siruvani project in Cormbatore District, and indications show that the project is fairly promising, and that electrical energy of considerable magnitude could be developed with a fairly reasonable chance of showing profit. If Mr. Meares's reports are favourable there is every hope that some at least of the projects will materialise in due course.

CORRECTION.—With reference to the Hyderabad note appearing on page 778 of our May 28th issue, a correspondent in India sends one or two corrections. He says that one of the outlying palaces of H.H. the Nizam was fitted with a private plant about ten years ago, but this has no connection whatever with the public supply, which was commenced about 4½ years ago. No public supply was given in Hyderabad previous to that date. The new turbine sets are of 1,000-KW. capacity each, not 1,500. The current is used for ordinary supply purposes, and for a very considerable quantity of industrial work, including some 150 KW. for the constructional machinery used at the building of the big dam mentioned, which, unfortunately, owing to its having practically no head, could by no possibility be used as a source of energy for the production of electricity.

Germany's Reserve of Copper.—In a recent issue of the *Génie Ciril* M. F. Loppé has an interesting article on the reserves of copper available to the German Government in the form of cables used for the transmission and distribution of electricity. He draws attention in this connection to the rather precipitate decision of the municipality of Berlin to purchase the electricity supply undertakings within its area, at a cost of 288 million marks; the question of purchase had been under consideration for a long time, and its speedy settlement at this time suggests that the motive underlying the transaction is the desire to replace the copper mains with steel cables. The author recalls the fact that before the end of 1914 the German Electrotechnical Society had instructed its general secretary, Herr Dettmar, to draw up rules for the use of iron in place of copper in electric networks, and points out that, as no important new installations can be in contemplation, the object in view must have been the substitution of copper for iron in existing networks.

With a view to ascertain the extent of these reserves of copper, M. Loppé has made calculations which lead to the conclusion that in the case of lighting and tramway undertakings on the average about 20 kg. of copper will probably be in use per kilowatt of plant connected, and in the case of power systems 7 kg. per kilowatt. Published statistics show that in Germany there were probably at the beginning of the war 4½ million KW. installed —1·7 millions for lighting, requiring 34,000 tons of copper, 2·3 millions for power and heating, requiring 16,000 tons of copper, and 220,000 KW. for traction, requiring 4,400 tons of copper—the total weight of copper available being therefore 54,400 tons. The author considers that by basing his calculations on the consuming plant installed and not upon the power of the generating plant, which is generally 60 per cent. of the former, he has obtained a result which is certainly greater than the true value.

How far the copper could be replaced by iron is an extremely difficult question, especially in the case of A.C distribution. Heavy aerial cables would have to be replaced by iron cables so weighty and exposing so large a surface to wind pressure that it would be almost impossible to strengthen the insulators and poles sufficiently to carry them. It is also doubtful whether iron cables of adequate section could be drawn into underground conduits designed for copper cables. Hence the author concludes that the figure of 54,400 tons is certainly far greater than the amount that could actually be availed of, and puts it forward only with a view to fixing ideas as to the order of magnitude of the copper reserves in Germany's cables.

Coal Supplies.—A Bill was introduced on July 13th by the President of the Board of Trade which embodies the recommendations of the Parliamentary Committee which has been considering the question of coal supplies. In present form the recommendations are:—

1. That during the continuance of the war the maximum price of coal at the pithead for consumption at home and by our Allies should be fixed on the basis of the prices charged for substantial quantities of each class of coal sold during the 12 months preceding the war, with the addition of 4s. 3d. a ton, or such other sum as may be prescribed, to cover the increased cost owing to the existence of the war.

2. That the rate for coasting steamers employed in the coal trade be fixed on the basis of the rate charged for freight during the 12 months preceding the war, with an addition of such sum as will reasonably cover the increased cost owing to the existence of the war, and that the Government be urged to assign a further number of the interned steamers for the use of the coal trade.

The *Morning Post* says that the colliery proprietors objected to the sum named as being insufficient, but the Bill will, it is believed, carry out generally these recommendations. The fixing of prices will be undertaken by local Committees, because prices vary in a marked fashion, not only as between districts but even as between pits.

The same paper mentions the report of the manager of a group of pits that during June weekly absence rose from 3 to 9 per cent., representing a total output lost of well over 3,000 tons of coal, and quotes his opinion that the war bonus for men earning over £2 a week has been simply an inducement to idleness.

He further mentions the case of a man who wanted a loan of 30s., although during the previous two weeks he had earned £6 15s. and been absent nearly two days.

The Electrolytic Insulation of Aluminium Wire.—In the course of a paper read before the American Electrochemical Society, Messrs. C. E. Skinner and L. W. Chubb described a process by means of which they are able to produce an insulating film of high dielectric resistance on the surface of aluminium wire. Electrolysis plays an essential part in the process, on the principle of the aluminium rectifier; the best electrolytes are solutions of borax, borate of aluminium, and, above all, sodium silicate. Economical results are attained by the use of a high current density and high voltage. According to the gauge of wire, the speed of treatment ranges from 12 to 45 m. of wire per minute, and the energy expended from 0·15 to 0·80 watt-hour per sq. in. of surface treated. The white pellicle obtained with silicate of soda at a pressure of about 425 volts is rather soft to the touch, but so firm that it cuts and wears the hand when one winds the wire on bobbins. Its dielectric resistance is much greater than that of the coating of oxide obtained by other processes; two wires so treated and tightly twisted together withstand a pressure of 200 to 500 volts. The thickness of the film varies between 0·00025 and 0·001 cm.; it is very flexible, and does not flake off or appreciably weaken when the wire is bent at an acute angle. The wire can also be stretched 30 per cent. without injuring the insulation. Two wires at a potential difference of 250 volts can be crossed and crushed together to the thickness of a single wire without metallic contact, so long as there is no rubbing motion between them; but the least movement of one of them cuts through the insulation and produces a short-circuit.

Sewer Gas for Generating Electricity.—The *Sydney Morning Herald* reports an interesting demonstration at the Parramatta sewage pumping station of the possibilities of sewer gas for commercial purposes. The patentee of the sewer gas system (Mr. H. Walshaw, sanitary engineer for Parramatta municipality) stated that with a 15-H.P. engine he was now able to do all the pumping required in connection with the sewerage system, and dispense with any night supervision whatever. He estimated that the work absorbed 250 cb. ft. of sewer gas per 24 hours, whilst he had 1,700 cb. ft. per 24 hours available. He was convinced that the value of sewer gas was such that, with the potential resources at the outfall of the Bondi sewer, sufficient power could be generated by the gas to light electrically the city of Sydney, and also run the metropolitan tramway system.

Educational.—City and Guilds of London Institute.—The report of the Council for 1914 states that the number of students attending the City and Guilds (Engineering) College in July last was 411, as compared with 429 in the previous session, the decrease being due to the transfer of the Chemical Department to the Royal College of Science; at the Technical College, Finsbury, there were 194 day students, as against 177 in the previous session, and 140 in the one before that. But the outbreak of war had a very marked effect on the entries for the current session. About 224 students enlisted or were called to the Colours, and the total for the two Colleges in March, 1915, was 402, compared with 605 in the previous year. The main decrease was in second and third year students, the entry of new students who are under military age being well maintained. Of the staff, 32 teachers and workmen are serving with the Forces. On the declaration of war, arrangements were made to ensure that the positions and prospects of students and employés who went on active service should not be prejudiced.

The Roll of Honour includes the names of 633 past and present members of the staff and students of the City and Guilds (Eng.) College (341 officers, 292 men), and 206 from the Technical College, Finsbury—total, 839. During the past three years the number of students attending the Electrical Engineering Course at the City and Guilds (Engineering) College has been practically constant at an average of 77; at Finsbury there were 63. The total income for 1914 was £29,467, and the expenditure £29,558.

The programme of the Technical College, Finsbury, for the session 1915-16 was recently issued; it contains a number of views of the new mechanical, engineering and hydraulic laboratories, as well as of the dynamo and generating rooms, the calibrating room, the magnetic and electrical laboratories, &c. Dr. S. P. Thompson, F.R.S., the principal, is professor of applied physics and electrical engineering, assisted by Mr. J. K. Catterson-Smith, Mr. C. R. Darling, Mr. R. P. Howgrave-Graham, and others.

Particulars of the Day Courses at the City and Guilds Technical College, Finsbury, appear in our advertisement pages to-day.

Imperial College of Science and Technology, South Kensington, S.W.—City and Guilds (Engineering) College.—Particulars of courses in mechanical, civil and electrical engineering, mechanics and mathematics are obtainable from the Registrar, Imperial College of Science and Technology, South Kensington, S.W. See also our advertisement pages to-day.

U.S. Trade Relations with Latin America.—As a result of the Pan-American Financial Conference, the Secretary of the Treasury has appointed a number of prominent business men and financiers of the United States to act on Committees which are to promote closer trade and other relations between the United States and Latin America. Ten members, including Secretary McAdoo, will constitute an International High Commission, authorised by the conference to deal with uniformity of legislation in Pan-American countries, including laws on trademarks, patents, and copyrights; bills of exchange, commercial paper, and bills of lading; uniform classification of merchandise, Customs regulations, port charges, &c. It has been suggested that the International High Commission meet in Buenos Ayres on November 1st, 1915.

Female Kinematograph Operators.—The Theatre and Music Halls Committee of the London County Council, having considered a suggestion with regard to the employment of women operators in kinematograph halls, with a view to releasing men for military service, recently drew the attention of the Home Secretary to the matter, and informed him that women had hitherto only been employed in London in two cases; the operator must possess some electrical knowledge, and in practice was generally responsible for the maintenance of the electrical equipment of the hall and the execution of minor repairs, but there did not appear to the Council to be any reason why women should not be able to acquire the requisite degree of knowledge and skill; and in the circumstances, the Council was of opinion that no objection should be raised to the employment of competent women as kinematograph operators.

Admiralty Board of Inventions.—The Admiralty has announced that the arrangements for the organisation of the Board have now been completed. It will comprise a Central Committee and a Panel of Consultants, composed of scientific experts, who will advise the main Committee on questions referred to them.

The Central Committee will consist of:—Lord Fisher of Kilverstone (President); Sir J. J. Thomson, Hon. Sir C. A. Parsons, and Mr. G. T. Beilby.

The Consulting Panel will comprise the following list, which will be added to from time to time as necessary:—Prof. H. B. Baker, Prof. W. G. Bragg, Prof. H. C. H. Carpenter, Sir William Crookes, Mr. W. Duddell, Prof. Percy Frankland, Prof. Bertram Hopkinson, Sir Oliver Lodge, Prof. W. J. Pope, Sir Ernest Rutherford, Mr. G. Gerald Stoney, and Prof. the Hon. R. J. Strutt.

Communications should be addressed to the Secretary, Board of Invention and Research.

The Belgian military authorities have established at 21, City Road, E.C., a branch office of the Belgian Service of Military Inventions, which has its headquarters in Paris. Like the French Army, which has a permanent commission for the study of technical inventions connected with each arm, the Belgian Army has organised a technical Commission of Inventions, whose delegates are accredited to the various departments of the French Commission. The Bureau now opened in London will inform the Belgian War Minister of all new military inventions likely to be of use in the war. The officers in charge of this office will be glad to receive details of military inventions, especially from British firms engaged in the manufacture of munitions and arms for the Allied Armies.

Mr. T. A. Edison has accepted the invitation of the Secretary for the U.S. Navy to head the Advisory Board of Civilian Inventors for the Bureau of Invention, a development which the Navy Department is about to create in order to secure the inventive genius of the country to meet new problems arising from the European war, especially in connection with submarines.

Professional Etiquette.—The application of Mr. J. S. E. de Vesian for an injunction against the Council of the Institution of Civil Engineers, to restrain it from interfering with his rights as a member, which was refused by Mr. Justice Neville, has been allowed by the Court of Appeal. The Master of the Rolls pointed out that the appellant only sought an injunction until the trial of the action; it would not hurt the defendants, and would prevent injury to the plaintiff pending the decision of the case.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Hackney B.C. is recommended to appoint Mr. P. M. Shears, canvasser of the electricity department, to be sales department foreman, at a salary of £190 during the period of the war.

The salary of Mr. W. A. H. Parker, assistant manager of the Heywood Corporation electricity works, has been advanced by £13 per annum, and the salary of Mr. W. A. Ireland, meter inspector, by £6 10s. per annum.

Mr. Harry Davies, public lighting superintendent to the Swansea electricity department, has accepted a commission in the Army.

Whitby U.D.C. has deferred until the end of the war the question of increasing the salary of the electrical engineer, Mr. Piggott.

Mr. A. J. Howard, borough electrical engineer at Taunton, has been presented on his marriage with a silver salver, by the members and officials of the Corporation.

General.—Mr. G. R. G. Conway, chief engineer of the British Columbia Electric Railway Co., Ltd., has resigned his post, which he has held for 4½ years, and has been appointed consulting engineer to the company. He will carry on general consulting practice in a wider field, and is opening an office in Toronto this month. Mr. Conway went to British Columbia in December, 1910, as consulting engineer in connection with the construction of Coquitlam Dam for the Vancouver Power Co., and in January, 1911, was appointed chief engineer to the British Columbia Electric Railway and its various subsidiary companies. During his period as chief engineer he has been responsible for the design and construction of all the company's large works, which have involved a capital expenditure of between 17 and 18 million dollars. Prior to going to Vancouver Mr. Conway represented Messrs. Mackenzie & Mann in Mexico as their chief engineer for the Monterey Railway, Light and Power Co. Mr. Conway was educated at the Hartley University College, Southampton. In 1898 he entered the service of the City of Aberdeen as its resident engineer, and he left there after eight years to carry out the works in Monterey, Mexico. Mr. Conway has taken an active part in the work of the Vancouver Branch of the Canadian Society of Civil Engineers, having been its chairman for the past two years and a half. Mr. Conway is a member of the Council of the Canadian Society of Civil Engineers, a member of the Institution of Civil Engineers, and he holds the Telford gold medal of that Institution; he also represents the Council as a member of their Advisory Committee for Canada.

The Perth (W.A.) City Council recently met to consider the appointment of a general manager of the electricity and gas departments. According to the *Commonwealth Engineer* there were 37 applicants. Some councillors wanted to know the necessity for a general manager, seeing that they already had two managers, one of whom was receiving £800 a year. The number of applicants was reduced to seven, and the majority of votes was given to Mr. B. L. Murray, local manager of the Victoria Insurance Co., who had at one time served with Messrs. Siemens Bros., but had devoted most of his business career to insurance. Until two months ago he was a member of the Perth Council. When Mr. Murray was informed of his election, he wrote asking to be relieved of the appointment, and another Council meeting was called at which, "after considerable wrangling," it was resolved to ask the six persons whose names were left in the final ballot, whether they were desirous that their applications should stand for reconsideration.

On July 15th, at Harpenden Parish Church, the marriage took place of Miss Marjorie Flora Down, daughter of Mr. Fred. J. Down, M.I.E.E., and Mr. Philip Blake, L.D.S., &c, of Portsmouth. A reception afterwards followed at "Glengariff," the residence of Mr. Down.

Mr. George G. L. Preece, who for some years has been in charge of the Manchester office of Messrs. Bruce Peebles & Co., Ltd, has temporarily left that company's employment owing to his having accepted a commission in the Lancashire Fusiliers. During his absence Mr. E. W. Browne, the company's representative in Birmingham, will act as manager in Manchester.

MR. ERNEST EMERSON STOCKENS, of Aberdeen, district telephone manager for the North of Scotland district, has been appointed manager of the Blackburn district.

The marriage took place recently at Farnborough (Hants.) of MR. BERNARD W. GOTHARD, A.M.I.E.E., and Miss Gertrude Frances Pierce, youngest daughter of the late Mr. Wm. Pierce and of Mrs. Pierce, of Canterbury.

Roll of Honour.—Much sympathy will be extended to MR. WILSON HARTNELL, of Leeds, in the great loss which he has sustained by the death of his only son Lieut. Cuthbert Hartnell. Lieut. Hartnell went to France with the 1st/8th Battalion West Yorks. Regiment (Leeds Rifles), and was killed in action on July 16th. He was in his 28th year. Educated at Bedford Grammar School he secured school honours as a sportsman, and later in Leeds acted as secretary of the local polo club. His training as an engineer was obtained at the Leeds University, and afterwards he became an Associate of the Institution of Civil Engineers and a director of the firm of which his father is the head. It was through the medium of the Leeds University Officers' Training Corps that Lieut. Hartnell secured his commission some five years ago. He was a member of the Leeds Court of Referees under the National Insurance Act.

Private LAMECH JORDAN, an electrician employed at the British Electric Traction Co.'s power station, Dudley, is officially reported to have fallen at Ypres.

Able Seaman J. E. BOLLAND, of the Nelson Battalion, Royal Naval Division, has been killed in action at the Dardanelles. He was formerly an electrician with Electrical Services, Ltd., of Bradford.

Private J. W. BROWN, of the 7th Manchester Regiment, who was on the staff of Messrs. Mirrlees, Bickerton & Day, Ltd., of Hazel Grove, Stockport, has been killed in action in the Dardanelles.

Lieut. LAWRENCE TURNBULL, who has been killed in action, was until October last with the Westinghouse Electric Co. at New York, and he returned to England to take a commission in the Bedfordshire Regiment.

Obituary.—MR. H. A. MAVOR.—We deeply regret to record the death of Mr. H. A. Mavor, M.I.C.E., M.I.E.E., which occurred on 16th inst. He was the founder, 30 years ago, of the well-known firm of Mavor & Coulson, electrical engineers, Glasgow. He did, in the early days, much pioneering work in connection with the electrical industry, and the generating stations put down and operated by his firm were taken over by the Glasgow Corporation to form the nucleus of the enormous electricity supply undertaking which that authority to-day controls. Subsequently Mr. Mavor directed his energies and his original and inventive resources to the design and manufacture of electrical machinery, and his firm has been in the front rank for the last 25 years. The latest important work which engaged his attention was the problem of electric propulsion of ships. His experimental work on a practical scale included the equipment of the *Electric Arc*, a vessel of 2,000 tons, with electric propelling machinery. Very full particulars of his work in this direction have been published in the ELECTRICAL REVIEW, and during the last few years Mr. Mavor had read many papers on the subject before engineering societies and the British Association. His last two visits to America were made in the capacity of consultant to the company which equipped the United States Navy collier *Jupiter*, a vessel of 12,000 tons, with electric propelling machinery. As the result of the success of the *Jupiter*, a further notable step has recently been announced in the placing of a contract with the same company for the electric machinery for driving the new 30,000-ton battleship *California*, for the United States Navy. The funeral took place on Monday, at the Western Necropolis, Glasgow.

MR. H. C. HAROLD.—We regret to learn just as we go to press of the death of Mr. H. C. Harold, which occurred on Monday last. Mr. Harold had been throughout the greater part of his life connected with the electrical industry on its commercial side. We knew him first of all at Clark & Muirhead's; subsequently he was associated with Johnson & Phillips at their City office; he later entered into partnership with Mr. Robert Jenkins (1886-1893), and connections with certain electric lamp companies followed. He was 63 years. The funeral takes place to-day, Friday, at West Norwood at 3 o'clock

Will.—The *Times* states that the late SIR JOHN CAMERON LAMB, former Second Secretary of the General Post Office, left £8,023 gross, with £7,815 net personalty.

NEW COMPANIES REGISTERED.

New Era Signs, Ltd. (140,951).—This company was registered on July 12th, with a capital of £5,000 in £1 shares, to acquire and develop an invention for improvements in or relating to flashlight advertising devices; to carry on the business of manufacturers of and dealers in apparatus for displaying electric and other advertisements, dynamos, lamps, wires, cables, insulating materials, accumulators, telephone and other apparatus, electrical and mechanical engineers, etc., and to adopt an agreement with the Magna Charta Publishing Co., Ltd. The subscribers (with one share each) are: D. Nimmo, Abchurch House, Sherborne Lane, E.C., solicitor; Phyllis M. Holden, 232, The Park, Tottenham, N., clerk. Private company. The number of directors is not to be less than two or more than seven; the first are not named. Registered office: 59, New Oxford Street, W.

Beacon Carbons, Ltd. (140,966).—This company was registered on July 14th, with a capital of £5,000 in £1 shares, to carry on the business of manufacturers of and dealers in carbons for electric arc lamps, makers of all kinds of electrical equipment, fittings and machinery, manufacturers of and dealers in appliances for electric lighting, and cables for the transmission of electric current, etc. The subscribers (with one share each) are: C. W. Webster, Villa Road, Bingley, electrical engineer; Mrs. A. M. Webster, Villa Road, Bingley. Private company. The first directors are C. W. Webster and Mrs. A. M. Webster. Solicitors, Neill & Dawson, 1, Piccadilly, Bradford. Registered office: Whitley Street, Bingley, Yorkshire.

John Russell and Co., Ltd. (140,981).—Registered July 15th, by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C. Capital, £200,500 in £1 shares (150,000 6 per cent. pref.). Objects: To take over the business of John Russell & Co., Ltd. (incorporated in 1876), to carry on the business of tube manufacturers, factors and merchants, coalmasters, ironmasters, dealers in gas, steam, locomotive, hydraulic, metallic and other tubes, gas and other fittings, chandeliers, gasoliers, and other articles, etc., and to adopt an agreement with the said old company and the liquidator thereof. The signatories (with one share each) are: Lt.-Col. W. E. Harrison, Wychnor Park, Burton-on-Trent; T. A. Negus, Shenstone Lodge, Lichfield, gentleman; F. R. Clarke, Fossway, Lichfield, solicitor; J. C. Forrest, Easington, Wolverhampton, mining engineer; C. Marshall, Highgate, Walsall, secretary; A. W. Hulton, Wayside, Streetly, engineer; C. L. Simpson, 13, Montague Place, W., engineer. The first directors (to number not less than three or more than seven) are: Lt.-Col. W. E. Harrison, T. A. Negus, F. R. Clarke, and J. C. Forrest. No qualification for first directors. Qualification of subsequent directors, £100 ordinary or £250 preference; or a combination of ordinary and preference shares, in which case £1 ordinary shares shall be equivalent to £3 10s. preference shares. Remuneration, £500 per annum, divisible. Solicitor: J. R. Holliday, 4, Bennett's' Hill, Birmingham.

Berry and Hayward, Ltd. (140,957).—This company was registered on July 13th, with a capital of £2,000 in £1 shares, to take over the business carried on at Nottingham, as "Berry and Hayward," to adopt an agreement with J. G. Berry and A. T. Hayward, and to carry on the business of electrical engineers and contractors, manufacturers of and dealers in electrical apparatus and appliances, manufacturers of electric cables and incandescent lamps, brassfounders, wire workers, metal tube manufacturers, etc. The subscribers (with one share each) are: J. G. Berry, 18, Glebe Road, West Bridgford, electrical engineer; A. T. Hayward, Glendale, Harlington Road, Sherwood, Nottingham, electrical engineer. Private company. The number of directors is not to be less than two or more than five: the first are J. G. Berry and A. T. Hayward. Qualification, £100. Solicitor, E. B. Stocker, 12, Zulla Road, Nottingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Electric Distributing Corporation, Ltd. (79,057). Capital, £31,000 in £1 shares (13,000 cum. pref., 3,000 pref. ord., and 15,000 ord.) Return dated August 12th, 1914 (filed May 20th, 1915). 9,715 cum. pref., 2,600 pref. ord., and 8,893 ord. shares taken up; £18,415 10s. paid; leaving £2,792 10s. in arrears. Mortgages and charges: Nil.

Leatherhead and District Electricity Co., Ltd.—Trust deed dated June 30th, 1915 (supplemental to trust deed dated July 2nd, 1912), to secure an issue of £10,000 debenture stock, ranking *pari passu* with £15,000 like stock issued under principal deed, charged on land with buildings thereon at Fetcham, Surrey, and company's other assets, present and future, including uncalled capital. Trustees: P. P. Ralli, Ashstead Park, Surrey.

Trafford Power and Light Supply (1902), Ltd.—Particulars of £40,000 debentures, created by resolutions of March 30th and June 22nd, 1910, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £15,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Pintsch's Electric Manufacturing Co., Ltd. (in liquidation).—Charge on company's hereditaments, and premises, capital stock, machinery, goods, chattels, debts and other assets, dated June 30th, 1915, to secure £200 and further advances stamped up to £2,250. Holders: Pintsch's Patent Lighting Co., Ltd. (in liquidation), Friars House, New Broad Street, E.C., and H. W. Kirby, Bassishaw House, Basinghall Street, E.C., the liquidator.

G. H. Turner and Co., Ltd.—Issue, on July 12th, 1915, of £60 debentures, part of a series of which particulars have already been filed.

Anglo-Foreign Tramway Syndicate, Ltd. (112,859).—Capital, £10,000 in 9,500 pref. shares of £1 each, and 5,000 "A," 4,000 "B," and 1,000 ord. shares of 1s. each. Return dated August 19th, 1914 (filed May 31st, 1915). 4,200 pref., 379 "A," and 74 "B" shares taken up; £1 per share called up on the pref. and 1s. per share on the "A" and "B"; £4,222 4s. paid. Mortgages and charges: Nil.

Alert Electrical Co., Ltd. (78,971).—Capital, £2,000 in £1 shares. Return dated March 27th, 1915. 708 shares taken up; £708 paid. Mortgages and charges: Nil.

Hong Kong Tramway Co., Ltd. (75,486).—Mortgage created outside the United Kingdom, as additional security, dated April 28th, 1915 (supplemental to trust deed dated July 1st, 1903, securing £195,000 debentures), charged on certain land with premises thereon in Victoria, Hong-Kong. Trustees: United Exploration Co., Ltd., 19, St. Swithin's Lane, E.C., and the Consolidated Trust, Ltd., Dashwood House, New Broad Street, E.C. A memorandum of satisfaction to the extent of £2,500 on June 28th, and £600 on July 6th, 1915, of trust deed dated July 1st, 1903, securing £195,000, has been filed.

Wrexham Motor and Electrical Engineering Co., Ltd. (84,046).—Capital, £5,000 in £1 shares. Return dated May 25th, 1915. 928 shares taken up; £928 paid. Mortgages and charges: £600.

CITY NOTES.

Chili Telephone Co., Ltd.

MR. GEO. KEITH presided, on July 14th, over the annual meeting, held at 42, Old Broad Street, E.C. Prefacing his remarks with an allusion to the absence of Mr. E. C. Quilter and Mr. E. B. Butler Henderson, two directors, on active service, he said that the year under review had been very abnormal, and one of great difficulty for the business in Chile. The company's revenue increased very favourably during the first four months of the year, but then came the crisis due to the outbreak of the European war, closing Chile's principal markets for the export of nitrate, her chief source of revenue. The subsequent naval activities off the west coast also interfered greatly with her shipments. Exchange fell to 7d., lower than it ever was before, and the whole business of the country became difficult and seriously depressed. The aggregate number of

subscribers fell off about six per cent., due to the telephones being given up in consequence of economy or bad business. Fortunately, the loss of revenue incurred thereby was more than compensated for by the increase in the first four months' working; and the gross currency showed a small increase on the year. The working expenses had also increased. The winter in Chile was very severe, and the company's overhead plant in some districts suffered badly from storms and inundations, which rendered its maintenance both difficult and expensive. The total working expenses were equal to 54 per cent., and the net currency showed a small decrease on the year. The lower value of the Chilean dollar reduced the average rate of exchange to about 8½d., or nearly 12 per cent. less than it was for the previous year, and the net income in Chile when converted into sterling showed a decrease on the year of £8,030. The total income from all sources amounted to £54,392. Considering the set-back which the company had suffered in consequence of the abnormal conditions in Chile due to the war, he congratulated the shareholders upon the result of the year's working. The general reserve now stood at £96,000. The depreciation of the sterling value of the liquid assets due to the fall of exchange amounted to £6,344. This item occurred more or less every year, and went against or for the reserve according as the exchange rose or fell during the year. Investments remained unaltered, and a special reserve of £5,000 now covered the depreciation in their market value, which had, unfortunately, increased during the past year. The capital expenditure was increased by £6,137 expended on extensions to the property and plant. Amongst the new works carried out was the purchase of two sites for building a new exchange and the opening of two new offices. Several inter-town lines had also been built, and a further extension made to the underground system in Santiago. Since the commencement of the present year the general situation in Chile had shown signs of improvement. The shipment of nitrate had been renewed, but any great era of prosperity was not to be expected while the war lasted. High prices were also benefiting the mining and agricultural interests, and were leading to an increase in the exportation of these products, while the reduction of public expenditure and war imports was producing a healthy state of things in the money market. The business, as far as it had gone this year, showed an improvement which it was hoped might continue and at least cover the set-back which had taken place since the war broke out. The Chairman concluded with an expression of appreciation at the loyal manner in which the staff had carried on the work during the past most strenuous and difficult year.

Mr. Charles W. Parish seconded the motion, and the report was adopted.

British Electric Traction Co., Ltd.

The scheme for the reduction and re-arrangement of the capital of the British Electric Traction Co., Ltd., as modified since the referendum on the proposals, is now before the proprietors. It appears in tabulated form below:—

Proposed Reduction and Rearrangement of Capital of the B.E.T. Co.

Present Issued Capital.		Proposed to be converted into: 6% cumulative participating preference stock with priority as to capital.		New ordinary stock ranking after the preference stock as to capital and dividends.		Proposed to be written off.	
Issued—	£	%	£	%	£	%	£
6 % Cumulative preference stock	403,592½	100	403,592½				
7 % Non-cumulative preference stock	807,185	35	282,514¾	65	524,670¼		
6 % Pref. ordinary non-cumulative stock	1,070,097½			50	535,048¾	50	535,048¾
Deferred ordinary stock	666,505			30	199,951½	70	466,553½
All the above stocks rank equally as regards capital.	£2,947,380		686,107¼		1,259,670½		1,001,602¼
Non-interest-bearing income certificates, £266,371 1/-		10	Add 26,637	25	Add 66,593		Deduct 93,230
Entitled to redemption by purchase or drawings out of a sum to be set aside out of the profits available for dividend in each year equal to the sum paid by way of dividend for that year on the preferred ordinary stock.			£712,744¼		£1,326,263½		£908,372¼
			£2,039,007¾				Representing the net result of the scheme on the issued capital of the company.

The issued capital of the company, now standing at £2,947,380, will be written down by £1,001,602; or, if the £266,371 in income certificates are included, the net effect of the scheme is to reduce the capital by £908,372. The two classes of preference stock and the two classes of ordinary stock (all ranking equal as regards capital), together with the income certificates, will be converted into £712,744 new 6 per cent. cumulative participating preference stock with priority as to capital, and £1,326,263 ordinary stock ranking after the preference both as to capital and dividends. The present 6 per cent. cumulative preference stock is not called upon to bear any portion of the capital reduction, and is converted in its entirety into the new preference stock. As compensation for the fact that the re-arrangement increases the total amount of preference stock, priority as to capital is conceded to the new preference stock, and also a right to participate in further profits up to 8 per cent. after the new ordinary has received 8 per cent. in any one year. The holders of the present 7 per cent. non-cumulative preference stock will convert into 35 per cent. of new preference stock and 65 per cent. of new ordinary stock, retaining, in common with the 6 per cent. preference stockholders, the full percentage of their holdings. Upon the ordinary stockholders falls the reduction of the capital. The 6 per cent. preferred ordinary non-cumulative stock will receive 50 per cent. in new ordinary stock and 50 per cent. will be written off; the deferred ordinary stock will secure 30 per cent. new ordinary stock and 70 per cent. will be written off. The income certificates are to be exchanged into 10 per cent. of new preference stock and 25 per cent. of new ordinary stock.

Marconi's Wireless Telegraph Co., Ltd.

The report for the year ended December 31st, 1914, shows that the gross profit was £371,072, and the net profit carried to the balance sheet £232,716, showing an increase of net profit of £110,392. Adding £76,550 brought forward, the balance now to the credit of profit and loss account is increased to £309,266. The basis of remuneration from the Government for the use of the company's high-power stations since the beginning of the war and other services not yet having been settled, it has not been possible to include any sum in respect of them in the profit and loss account of last year. These items will, therefore, have to be entered to the credit of the account of the current year. In the balance sheet, shares in associated companies and patents are again taken into account at their cost price, viz., £1,360,126, showing an increase of £61,382. This addition is mainly comprised of the company's proportion of the increased capital of the Russian company. The company's holdings in associated companies, except for these additions, have undergone no change during the year. The par value of shares held in associated companies now stands at £2,469,859, exclusive of shares which have no capital denomination. The amount which stood to the credit of share premium account has been transferred to general reserve account, which now stands at £867,530.

The French Company (Compagnie Française Maritime et Coloniale de Telegraphie sans Fil) has declared a dividend for the year 1914, at the rate of 10 per cent. on the ordinary shares and 31.25 francs per share on the founders' shares.

The Marconi International Marine Communication Co. has again shown substantial increase of business and profits. Dividends for the past year amounting to 10 per cent. have been declared, and £30,747 was placed to reserve and carried forward.

The Russian Company (Société Russe de Télégraphes et Telephones sans Fil) has made satisfactory progress. A dividend at the rate of 15 per cent. for the year 1914, as compared with 6 per cent. for the previous year, has been declared.

The Marconi Wireless Telegraph Co. of America earned increased profits for the year, but owing to the conditions prevalent in Europe, and the consequent necessity to defer the opening of their trans-Atlantic service, the directors decided meantime not to declare a dividend.

The outbreak of war caused considerable dislocation of the company's affairs as well as those of the associated companies. Businesses of importance which were on the point of fruition had had to be deferred; many negotiations which were in course of successful progress with foreign Governments had for the time being to be abandoned; the opening of the direct public telegraph services between this country and the U.S.A. and Spain have had to be postponed. In some cases, owing to the unfavourable rates of exchange, substantial sums have had to be deposited at interest with bankers abroad, and some payments from foreign Governments deferred with interest accruing until after the war. £4,347 due from the Turkish Government has not been received. In all these circumstances the directors consider it prudent to recommend the declaration of a dividend of 10 per cent. upon the ordinary shares; to place a further £100,000 to general reserve account, increasing that account to £967,530, and, after deducting the dividend of 7 per cent. paid earlier in the year upon the preference shares, to carry forward £69,497. The directors do not contemplate that any loss in consequence either of loss

in exchange or deferred payments will result, but having regard to the war, they consider they are best studying the interests of the shareholders in adopting a conservative policy. The board are gratified to be able to state that during the current year the company has been engaged to its fullest capacity in supplying the demands of the British, Colonial and foreign Governments. The orders in hand justify the anticipation that the volume of business this year will exceed that of any previous year.

Annual meeting: July 25th.

Kalgoorlie Electric Tramways, Ltd.

The directors report that for the year ended December, 1914, the gross receipts were £31,891, against £34,643, and the net profits £7,265, against £9,549. The depressed condition of affairs in Kalgoorlie during the past few years has been accentuated by the European war. The competition of motor-cars also continues to adversely affect the receipts. A system of return fares has been inaugurated to encourage travelling. Expenditure is kept as low as possible, but the tramway must be efficiently maintained, and there is a limit to the reduction of expenses. The car miles run were 582,114, against 568,000; passengers carried 2,125,094, against 2,266,361; earnings per car mile 13.12d., against 14.57d.; expenses 9.48d. per car mile, against 9.91d. The power supply units consumed were 632,165 (£7,242), against 610,370 (£6,994), the increase being accounted for by the additional mileage run on account of the motor-car competition, and the slightly higher consumption per car mile was due to additional road-making and the motor cars running over the tracks and the dirty rails forming a bad contact. During the present year it will be necessary to carry out a considerable amount of work in the way of renewals to cars, overhead lines, etc. The "A" debenture stock has been reduced to £48,000 by the purchase of stock. Owing to the inability of the company to maintain the full sinking fund the trust deed was varied with regard to the annual sum to be set aside for sinking fund. The reduction of the expenses to the present low level was made possible by the extra work done by the whole of the staff in Western Australia.

Mr. A. H. P. Stoneham presided, on Monday, over the annual meeting, held at the London Chamber of Commerce, E.C. He said that the war had had an adverse effect upon the company, as it had upon practically all enterprises. In addition, they continued to suffer from the unfair competition of the motor 'bus services and also from the depressed condition of the mining industry in Kalgoorlie. Kalgoorlie was dependent almost entirely upon the mines, and while the industry was keeping up as far as the deep mines were concerned, there were very few new discoveries taking place, and owing to the high price of labour it was impossible to work some of the low-grade mines. The result was that the country was not flourishing, and it was only natural that they should suffer in their receipts from the tramways. A year or two ago they hoped to receive benefit from the construction of the Trans-Continental Railway and from the development of the agricultural resources of the State, but in both respects they had been disappointed. Last year there was a serious drought all over Australia, which had had a very serious effect upon the finances of the country. In that respect matters were much more promising this year, for the drought had quite broken up. The construction of the Trans-Continental Railway was proceeding very slowly. With regard to their traffic, the Boulder line showed the heaviest decrease, due to the motor car competition, where they had been forced to run an additional 21,533 miles. The mileage had been slightly reduced on the other lines, with the result that the total for the year showed an increase of 13,614 miles. Their issue of return tickets had, he thought, had some effect on the motor-car competition and had helped them to keep some of their traffic. When one had to compete against motor-cars which paid no licence, and which only came out when the weather was fine and when there was a good demand, they were up against an almost impossible proposition. They were bound to run their services, wet or fine, passengers or no passengers. At one time he had an idea that the Government allowed the motor-car competition so that they might beat down the receipts of the tramways and then buy them up at a reduced price, but he did not think that even the Australian Government would find it easy to raise money to-day to buy up any enterprise. When they found their profits going down they had to meet the question of the debenture interest and the sinking fund. They found it was impossible to keep up the sinking fund at the rate prescribed by the trust deed. They, therefore, called the trustees together and took their opinion as to the best course to be adopted. They showed those gentlemen all the figures, and they advised them to call a meeting of the debenture holders and reduce the sinking fund. They acted upon that advice, and a resolution was passed reducing the sinking fund, so that the difficulty had been got over for the time being. Whenever they returned to a state of prosperity they would resume the sinking fund on its old basis. In the meantime they were in danger, for a few weeks, of the debenture holders coming in and taking the property from them. However, that danger had been averted, and they could only go on and do their best and hope for better days.

Mr. C. C. Baker seconded the motion.

Replying to a number of questions, the Chairman said that up to the end of May this year the gross receipts had amounted to £13,472, as against £12,830 for the same period in 1914. With regard to the sinking fund, they were liable under the trust deed to set aside £9,000 a year for interest and sinking fund. They were still liable to put away the profits up to that amount if they earned them, but they were not bound to put aside the full £9,000 if the profits did not admit of it. About £2,500 was required each year for interest, and the balance would go to the sinking fund. If the company could be pulled round it could only be done by the present directors, most of whom had a very intimate and long acquaintance with Australian affairs.

The report was adopted.

German Electrical Companies.

The Elektra A.G., of Dresden, which earned net profits of £18,900 in 1913 and paid a dividend of 6 per cent., reports gross profits of only £6,400 for 1914. This sum is disposed of by an allocation to the depreciation fund and the balance carried forward to 1915.

The Elektro-Treuhand A.G., of Hamburg, which is the joint financial institution of the A.E.G. and the Siemens group, earned net profits of £27,000 in 1914, which were derived from dividends on Hamburg Elevated Railway shares and from interest on bank deposits. It is intended to pay a dividend of 5½ per cent. on the paid-up capital, being the same rate as in 1913, when the net profits were £25,000.

The Dr. Paul Meyer A.G., which constructs electrical apparatus and instruments, reports that the turnover in 1914 declined below the level which is regarded as the profitable limit. The orders for the army first come into consideration for the year 1915, whereas the preparations for this work imposed a charge upon 1914. Under the circumstances, the past year resulted in a loss of £15,500, this comparing with net profits of £15,100 and a dividend of 7½ per cent. in 1913.

The Deutsch-Ueberseeische Elektrizitats Gesellschaft, of Berlin, reports that the economic crisis in South America became aggravated after the outbreak of the war in Europe, and was felt by all the company's undertakings, which are situated in Buenos Ayres, Santiago, Montevideo, etc. Nevertheless, the gross receipts in 1914 were higher at £1,618,000, as compared with £1,567,000 in 1913, but the taxes increased and a larger sum has been set aside for depreciation, so that the net profits amounted to £739,000, as against £736,000. A dividend at the rate of 10 per cent. has been declared on the ordinary capital of £6,000,000, this comparing with 11 per cent. in 1913. It would, however, have been possible to distribute the same rate as in 1913 if five per cent. preference shares for £1,500,000 had not become entitled to participate in the profits for the first time in 1914. The report gives details of the various undertakings, and it is mentioned that the competition of the Italo-Argentina company in Buenos Ayres is still scarcely perceptible.

Austrian Electrical Companies.

The undertaking of the *Budapester Allgemeine Elektrizitats Gesellschaft*, which is chiefly an electricity supply company, is to be absorbed by the City Council of Budapest. The company was formed in 1893, and its dividends since 1911 have been at the rate of 12½ per cent. It is considered that the purchase price will reach at least £1,250,000.

The Ver. Gluhlampen und Elektrizitats A.G., of Neupest, after making ordinary provision for depreciation, records net profits of £44,700 for 1914, as compared with £52,400 in the previous year. A war reserve fund has been created by the allocation of £12,500 for this purpose, and a further sum of £4,100 has been set aside for depreciation. The balance permits of the payment of a dividend of 8 per cent., this contrasting with 12 per cent. in 1913.

The report of the *Oesterreich. Siemens-Schuckertwerke* states that the total orders received in 1914 were less than in the preceding year, the decline particularly affecting contracts for public electricity works and tramways and the work of the cable factory. On the other hand, the department for the transmission of power for industrial purposes was unfavourably influenced to a lesser extent, as many firms engaged on army orders were compelled to improve their equipment so as to enhance their efficiency. The company's plant was adapted as far as possible to the production of munitions of war. The gross profits experienced a considerable reduction, and the net profits receded from £121,000 in 1913 to £79,000 last year, the dividend on the share capital of £1,333,000 falling from 7 per cent. to 5 per cent. in the two years respectively.

Lanarkshire Tramways Co., Ltd.—Interim dividend at the rate of 5½ per cent. per annum, less income-tax, for the past half-year.

Sao Paulo Tramway, Light and Power Co., Ltd.—The directors have declared a dividend of 2½ per cent. on the common stock.

Electric and General Investment Co., Ltd.—The report for the year ended May 31st, 1915, states that the gross profit was £7,243. After deducting all general charges, interest on debenture stock, transferring £2,409 to reserve, and adding £3,074 brought forward from last year, there remains £5,222, which is to be carried forward. The amount of £84,000 appearing as a provision for contingencies in the last balance-sheet has been debited with £4,255 in respect of losses incurred, and after transferring thereto £2,409 from profit and loss, there remains £82,154, which has been deducted from the value of investments and retained as an investment reserve fund.

Companies Struck off the Register.—The following companies have, according to notice in the *London Gazette*, been struck off the Register :—

Automatic Telephone Co., Ltd.
Hilo Manufacturing Co., Ltd.
Illuminated Signs, Ltd.
New Imperial Electric Lamp Co., Ltd.
Sudd Fuel (Suddite), Ltd. (registered September, 1911).*
West India and Panama Telegraph Co., Ltd. (registered July, 1869).*

* In these cases another company with the same title is in existence at the present time.

New Issues.—*Coventry Chain Co., Ltd.*—This company has been inviting subscriptions for 70,000 6 per cent. cumulative preference shares, and 50,000 ordinary shares, all of £1 each, for the purpose of works extensions and additional plant, &c., which are necessary in order to enable it to keep pace with the large business in hand.

Shawinigan Water and Power Co.—This company is inviting subscriptions for an issue of $1,237,500 new common stock, at $100 (par) per share.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange business is still quiet enough to permit members of the House to engage in munition-making and volunteer-work without such things interfering with the less stern duties of their daily life. Without a doubt, the 4½ per cent. War Loan has absorbed a very substantial proportion of the floating supply of capital which the public had available for investment. Its effect will be felt until such time as it is superseded by other borrowing, such as Mr. Bonar Law and several other Ministers have already hinted at in the various debates in connection with the loan. This season of the year, too, is always a slack one in the Stock Exchange. Times being out of joint, there is but languid interest taken in holidays as a whole, but the spirit of the dog-days is upon us, investment and speculation make little appeal now that everyone has locked up his savings in the War Loan, and the August Bank Holiday approaches.

The coal crisis in South Wales caused less anxiety in the Home Railway market than it would have done in normal times, inasmuch as it is argued that the railway companies are now being operated by the Government, and that the strike will have only a slight effect upon the industry as a whole. But as an influence over all the Stock Exchange markets, it has made its weight heavily felt. Strive as they may to find some strictly impartial ground which may enable excuses to be found for the miners' conduct, those who endeavour to be most fair admit that they can discover no solid ground for the miners to take up such a *non possumus* attitude, and condemnation of the methods by which they have sought to enforce their demands is as unanimous as it is bitter.

Steam stocks have given way a little, but the Undergrounds mostly maintain their values. Central Londons are none too firm, and while we quote 73 as the middle price for Central London ordinary stock, it is probable that a buyer would find it much easier to deal than a would-be seller. The Underground Electric Railway income bonds hold their price with a good deal of firmness at 75. The "A" shares enjoyed a spurt to 6s. Metropolitans have gone back a little. Districts at 13½ keep steady.

The Electric Lighting market exhibits the dulness which is its usual feature at this time of the year. City of London preference are 10s. lower, St. James's dropped to 7, bringing their yield to the round 7 per cent. on the money. Some, at least, of the electricity supply companies are likely to be engaged before long in the manufacture of munitions, and it may be that in this way they will find a useful aid to maintenance of returns in the dead season. The coal crisis presses upon this market, as it does also upon that for gas issues, the latter being decidedly depressed and out of favour.

Within the past few days Westminsters have been done at 7, County First Debenture at 96½, Edmundson's preference at 3¼, and the six per cent. non-cumulative preference at 20s. 6d. Metropolitans last week were dealt in at 2¾ for the ordinary and 3¾ for the preference, while Bournemouth and Poole second preference changed hands last Friday at 10¼ and a shade lower. To give some idea of the quietude of the market, we may add that up to the beginning of this week Kensingtons had not been dealt in since February, City preference since May, and many other of the ordinarily popular shares have not changed hands for over a month. South Metropolitan ordinary are wanted at about 15s.

Marconi's Wireless Telegraph Co. has provided one of the most interesting features of the week by the issue of its report for 1914. The net profits have been nearly doubled, but the dividend on the ordinary shares is halved, viz.: from 20 per cent. to 10 per cent.; while the dividend on the preference shares comes down from 17 per cent. to 7 per cent. The directors, instead of dividing the profits up to the hilt, have elected to put £100,000 to general reserve, raising that fund to £967,000, and the market is well satisfied with the cautious policy which the directors have adopted. The report mentions that the Russian Co. has announced a dividend of 14 per cent. for 1914, which is an increase of 9 per cent., but that the American Marconi directors have decided not to declare a dividend for a time, in consequence of the conditions prevalent in Europe. Nothing comes from the Canadian Marconi Co. Possibly, it may be stated at the meeting whether the Marconi Co. gets an allowance from our Government in respect of the German wireless news, which it collects and publishes with the consent of the Censor over here. The French and the International companies have both paid 10 per cent. for the past year, the Argentine and Spanish subsidiaries bringing nothing to the accounts. On the issue of the report, the shares fell a small fraction to 1 13/16, but the movement is only a third of the rise which occurred just previously. American Marconis have had a sharp rise, the price spurting to 13s. 9d. on buying, which is said to have its inspiration on the other side of the pond. Canadians remain at 4s. 3d., and Marconi preference at 31s. 3d. are a shade lower than they were a week ago.

Telegraph issues remain a very dull market. The necessity for raising money wherewith to pay the call for the full amount on the 4½ per cent. War Stock has led to further sales of securities throughout the markets this week, and to this cause must be traced the fall of 4 points in Eastern Telegraph ordinary, while the preference stock lost 1 in sympathy. Eastern Extensions fell ¼ to 11½, so that the shares are still relatively cheaper than Eastern Telegraph ordinary stock. The Anglo-American Telegraph issues are slightly easier, the preferred having now got to the round 100, while the deferred drooped to 21½. Globes are steady. New York Telephone bonds have been up to 96¼, but went back again to their previous price at 95½. Bell Telephone of Canada 5 per cent. bonds changed hands the other day at 101. West India and Panama shares are somnolent, not a bargain having been transacted in the ordinary for about six weeks. Great Northerns changed hands recently at 33¾—33. Henleys weakened to 14, losing their rise of last week. Other manufacturing shares connected with the telegraph industry are very steady.

Brazilian Traction common shares fell back to 49¼, although the Rio exchange keeps fairly steady. The Sao Paulo Tramway, Light & Power Co. has declared a dividend of 2½ per cent. on the common stock. The First Mortgage Debentures stand around 85 and the 5 per cent. Consolidated Debenture stock is nominally about the same figure. Mexican issues are a slightly better market, although no change has occurred in the quotable levels. The latest news, which comes *via* Washington, declares that the Carranza party is restoring order, and that telegraph and train services between Mexico City and Vera Cruz have been resumed. Adelaide 5 per cent. debenture stock gained a point to 99. The Anglo-Argentine Tramway group is generally lower, the 5 per cent. debenture stock shedding three points to 75, at which the return on the money comes to nearly 6¾ per cent., allowing for accrued interest.

The British Electric Traction Co. has now announced the details of its proposal for rearranging the capital. The scheme differs but slightly from that which was put forward just before the outbreak of war, but the 7 per cent. preference proprietors under the present proposal are to receive 35 per cent. new preference and 65 per cent. new ordinary, instead of 33⅓ per cent. and 66⅔ per cent. respectively. The income certificate holders are to be offered 10 per cent. preference and 25 per cent. ordinary, instead of 30 per cent. of the last-named stock. In the market the scheme is received in a friendly way, and it seems likely to go through. The prices of the various stocks at the present time are about 67 for the 6 per cent. preference, 40 for the 7 per cent. preference, 10 for the preferred ordinary, and 4 for the deferred.

The Electric & General Investment Co. has decided to carry forward its balance of £5,200, which remains after deducting general charges, interest on debenture stock, etc.

British Westinghouse preference and Electric Tractions have both lost 1s., and except for these, and the decline in Henleys already mentioned, the Miscellaneous Market is unchanged. Rubber shares have been good, and although scarcely as firm as they were at the end of last week, the undertone is decidedly strong. Notwithsanding the depression caused throughout the Stock Exchange markets by the news of the German advance on Warsaw, the rubber market held its own with a good deal of strength. The price of the raw material has shaded off a little because of the cessation, for the time being, of American demand, but those who closely watch the share market are confident enough of prices recovering before long, their contention being that rubber is so necessary for war purposes that the industry cannot help making big profits just now. In the Armament group there is less going on, but prices all round showed resistance to the dulness which overtook other departments on the Warsaw news, the latter counteracted to some extent, by the way, by the expectation that the coal dispute was, on Tuesday evening, about to reach an amicable settlement.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price July 20, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	6½	—	£6 1 8
do. 7 per cent. Pref.	7	7½	—	4 10 4
Charing Cross Ordinary	5	4	—	6 5 0
do. do. do. 4½ Pref.	4½	4	—	5 12 6
do. do. City Pref.	4½	3⅞ xd	—	5 16 2
do. 4 Deb.	4	82	—	4 17 7
Chelsea	5	4½	—	5 11 1
do. 4½ Deb.	4½	88 xd	—	4 17 10
City of London	9	13½	—	6 15 10
do. do. 6 per cent. Pref.	6	11½	— ½	5 4 4
do. do. 5 Deb.	5	105 xd	—	4 15 8
do. do. 4½ Deb.	4½	90 xd	—	5 0 0
County of London	7	11	—	6 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 1st Deb.	4½	96 xd	—	4 13 6
do. do. 2nd Deb.	4½	90	—	5 0 0
Kensington Ordinary	9	7	—	6 8 7
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4⅞	—	6 3 1
do. do. 4 Deb.	4	82	—	4 16 5
Metropolitan	8½	8	—	5 16 8
do. 4½ per cent. Pref.	4½	3⅞ xd	—	6 0 0
do. 4½ Deb.	4½	90 xd	—	5 0 0
do. 3½ Deb.	3½	70 xd	—	5 0 0
St. James' and Pall Mall	10	7	— ¼	7 0 0
do. do. do. 7 per cent. Pref.	7	6½	—	5 12 0
do. do. do. 3½ Deb.	3½	70 xd	—	5 0 0
South London	5	3	—	6 13 4
South Metropolitan Pref.	7	1⅛	—	6 4 5
Westminster Ordinary	9	7	—	6 8 7
do. 4½ Pref.	4½	4⅛	—	4 17 4
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100	—1	6 0 0
do. Def.	1½	21½	— ¼	6 19 6
Chile Telephone	8	6⅝	—	5 18 5
Cuba Sub. Ord.	5	8¼	—	6 1 8
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	11½	— ¼	*6 19 0
do. 4 Deb.	4	82½	—	4 17 0
Eastern Tel. Ord.	7	121	—4	*6 12 2
do. 3½ Pref.	3½	71	—1	4 18 7
do. 4 Deb.	4	81	—	4 18 9
Globe Tel. and T. Ord.	6	10	—	*6 17 0
do. Pref.	6	11½ xd	—	5 6 8
Gt. Northern Tel.	22	34	—	6 9 5
Indo-European	65/-	52	—	6 5 0
Marconi	10	14⅜	— 1/8	6 3 1
New York Tel. 4½	4½	95	—	4 13 0
Oriental Telephone Ord.	10	17	—	5 6 8
do. Pref.	6	1.3/16	—	5 1 1
Tel. Egypt Deb.	4½	88	—	5 2 3
United R. Plate Tel.	8	5⅞	—	*7 19 10
do. Pref.	5	4⅝	—	5 8 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12½	—	*6 10 6
do. 4 Deb.	4	83	—	4 16 5
Home Rails.				
Central London, Ord. Assented	4	73	—	5 9 7
Metropolitan	1½	25	— ½	5 0 0
do. District	Nil	18½	—	Nil
Underground Electric Ordinary	Nil	1⅝	—	Nil
do. do. "A"	Nil	6/-	+1/6	Nil
do. do. Income	6	75	—	*9 3 0
Foreign Trams, &c.				
Anglo-Arg. Trams, First Pref.	5½	4xd	— ¼	6 17 6
do. 2nd Pref.	5½	8½ xd	— ½	7 17 2
do. 4 Deb.	4	75 xd	—3	5 6 8
do. 4½ Deb.	4½	80 xd	—	5 12 6
do. 5 Deb.	5	75	—3	6 18 4
Brazil Tractions	6	49½	—2½	12 2 6
Bombay Electric Pref.	6	10½	—	5 16 10
do. 4½ Deb.	4½	90	—	5 0 0
Mexico Trams	Nil	33	—	Nil
do. 5 per cent. Bonds	—	50	—	Nil
do. 6 per cent. Bonds	—	80	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	30	—	Nil
do. 1st Bonds	—	45	—	—
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	99	+1	5 1 0
Manufacturing Companies.				
Babcock & Wilcox	14	2⅛	—	6 4 5
British Aluminium Ord.	5	1.3/16	—	4 14 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	11	—	6 13 4
do. Pref.	6	6	—	5 0 0
British Westinghouse Pref.	7½	35/-	— 1/-	8 11 6
do. 4 Deb.	4	70 xd	—	5 14 4
do. 6 p. lien	6	100	—	6 0 0
Callenders	15	11⅓	—	6 13 4
do. 5 Pref.	5	4⅛	—	5 2 7
do. 4½ Deb.	4½	95	—	4 14 9
Castner-Kellner	15	8½	—	4 12 6
Edison & Swan, £3 pd.	Nil	11/6	—	Nil
do. do. fully paid	Nil	1½	—	Nil
do. do. 4 Deb.	4	60 xd	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	12/6 xd	—1/-	9 12 0
do. do. Pref.	7	1 xd	—	7 0 0
Gen. Elec. Pref.	6	9⅞ xd	—	6 3 1
Henley	20	14	— ½	*8 3 3
do. 4½ Pref.	4½	4⅝	—	4 14 9
do. 4½ Deb.	4½	95	—	4 14 9
India-Rubber	5	8⅝	—	5 14 8
Telegraph Con.	20	33	—	7 5 6

* Allowance made for dividends being paid free of income-tax.

Western Union Telegraph Co.—The report for the six months to June 30th will show:—Revenue and income, $24,019,260; expenses, including maintenance and reserves, $19,359,745; interest on bonds, $668,600; net income, $3,990,915, being an increase of $1,891,080 over the corresponding period last year.—*Financial Times.*

Liverpool Overhead Railway Co.—Interim dividend to June 30th at the rate of 5 per cent. per annum on the preference shares and 2½ per cent. per annum on the ordinary shares, less income-tax at the rate of 2s. 3½d. in the £.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, July 21st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	4/6	..
a " Nitric	"	19/-	..
a " Oxalic	per lb.	..	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	£49	..
a Ammonia, Muriate (large crystal)	per ton	£40	..
a Bleaching powder	"	£9	..
a Bisulphide of Carbon	"	£21	..
a Borax	"	£22	..
a Copper Sulphate	"	£28	£1 dec.
a Lead, Nitrate	"	£35	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
e Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	7½d.	½d. inc.
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/6	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	..	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	£8	..
a " Lump	"	£8 10	..
a Soda, Caustic (white 70/72 %)	"	£10 2 6	..
a " Chlorate	per lb.	1/1	..
a " Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	4d.	½ . nc.
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
p Babbitt's metal ingots	"	£50 to £221	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1½ to 1/2½	..
c " Tubes (solid drawn)	"	1/2½ to 1/2½	..
c " Wire, basis	"	1/2 to 1/2½	..
c Copper Tubes (solid drawn)	"	1/2 to 1/2½	..
g " Bars (best selected)	per ton	£106	£4 dec.
g " Sheet	"	£106	£4 dec.
g " Rod	"	£106	£4 dec.
d " (Electrolytic) Bars	"	£95	..
d " " Sheets	"	£113	..
d " " Rods	"	£101	..
d " " H.C. Wire	per lb.	1/0½	..
f Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	1/10	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	2/6½	¾d. dec.
j Iron Pig (Cleveland warrants)	per ton	66/7	11d. dec.
l " Wire, galv. No. 8, P.O. qual.	"	£23	£1 inc.
g Lead, English Pig	"	£25 15	5/- inc.
g Mercury	per bot.	£18 5 to £18 10	£1 10 inc.
e Mica (in original cases) small	per lb.	4d. to 2/6	..
e " " medium	"	3/- to 5/-	..
e " " large	"	6/6 to 10/6 & up.	..
o Nickel, sheet, wire, &c.	"	Nom.	..
p Phosphor Bronze, plain castings	"	1/1 to 1/3½	..
p " rolled bars & rods	"	1/2 to 1/3½	..
p " rolled strip & sheet	"	1/3½ to 1/6½	..
e Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£80	..
g Tin, Block (English)	"	£167	£5 to £6 dec
n " Wire, Nos. 1 to 16	per lb.	2/8	..
p White Anti-friction Metals	per ton	£52 to £194	..
k Zinc, Sh't (Vieille Montagne bnd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
j Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

The Russian Rubber and Telegraph Co.—The Caoutchouc, Gutta-percha and Telegraph Co., of Riga, which is a Franco-Russian undertaking maintaining branches in Germany and Austria under normal circumstances, reports gross profits of £660,000 in 1914, as compared with £415,000 in the previous year. It has, however, been necessary to write off a considerable sum for doubtful debts apart from £165,000 for ordinary depreciation as against £100,000 in 1913, so that there only remains £180,000 available for distribution as contrasted with £252,000 in 1913. It is proposed to pay a dividend of £1 per share on the capital of £1,800,000, this comparing with £1·4 in the preceding year, but the actual payment is to be postponed until September owing to the depreciation in the Russian rate of exchange.

The Italian Westinghouse Co.—The Società Italiana Westinghouse, of Vado, reports that the course of business in 1914 was quite normal notwithstanding the war, the orders for military and naval purposes fully compensating for any lack of private contracts. The net profits amounted to £29,000, of which £15,000 has been applied to the extinction of losses in 1913, and the balance has been devoted to depreciation.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JUNE, 1915.

THE June returns of electrical exports show a welcome improvement on the figures of the previous month, the total of £417,769, comparing with £380,159 in May, and being not so much below the monthly average of 1914 as might be expected.

The imports and re-exports, on the other hand, show a falling off in value as compared with the previous month; the totals being for the former, £223,801 in June, and £268,848 in May, and for the latter £10,778 in June and £13,299 in May.

The increased exports total is traceable to improved business in telegraphic and telephonic material, electrical cables, goods and fittings; machinery exports fell off somewhat, as also did lamp and battery exports.

Decreased imports of machinery, cables and telegraphic and telephonic material account for the falling off in that section, though lamp imports—mainly from Holland—and carbon imports were higher in value.

Victoria was our best customer during the month, while in Europe, France and the Scandinavian countries made large purchases; Indian trade fell off during the month.

The United States supplied the bulk of the electrical imports, but the total was some £20,000 less than in May.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,802	4,731	472	1,936	596	2,025	3,815	440	806	107	12,647	10,633	41,010
German Colonies	...	...	...	...	...	...	28	...	...	...	...	53	81
Netherlands, Java and Dutch Indies ...	156	7,807	1,212	...	...	13	227	30	595	...	2,939	508	13,487
Belgian Congo...	17	...	...	41	...	...	...	...	...	...	...	65	123
France	852	358	975	12	4	63	4,565	1,3255	2,618	5	9,329	12,511	44,547
Portugal	...	77	50	87	10	68	317	11	31	...	259	329	1,239
Spain, Canary Isles and Spanish N. Africa...	448	126	550	173	22	565	1,530	11	25	7	871	198	4,526
Switzerland, Italy and Austria-Hungary ...	2,307	...	190	...	...	815	2,594	143	...	101	88	2,257	8,495
Greece, Roumania, Turkey and Bulgaria ...	536	...	23	29	...	...	149	...	24	...	385	5,145	6,291
Channel Isles, Gibraltar, Malta and Cyprus...	86	...	90	...	...	...	115	200	...	19	...	20,037	20,547
U.S.A., Philippines and Cuba	1,135	27	...	71	...	29	2,742	...	62	...	...	136	4,202
Canada and Newfoundland	246	178	50	128	...	1,748	1,741	...	825	7	32	84	5,039
British West Indies and British Guiana ...	116	124	68	58	...	...	408	...	20	25	52	57	928
Mexico and Central America	49	133	...	10	...	36	...	...	110	...	10	176	524
Peru and Uruguay	...	135	41	27	...	...	1,456	32	...	...	102	27	1,820
Chile	9	2,012	148	42	...	89	35	...	83	29	...	105	2,552
Brazil	517	776	431	300	10	...	3,128	379	30	28	52	713	6,864
Argentina	1,417	15,141	1,349	179	18	265	1,791	8,493	989	24	1,722	346	31,734
Colombia, Venezuela, Ecuador and Bolivia...	...	938	...	...	...	69	53	...	...	...	28	...	1,088
Egypt, Tunis and Morocco	237	555	128	138	...	...	877	60	594	11	301	92	2,993
British West Africa	...	278	...	...	...	...	351	...	...	6	60	181	876
Rhodesia, O.R.C. and Transvaal	911	775	1,001	967	...	247	1,424	16	700	203	16	31	6,291
Cape of Good Hope	1,848	1,098	1,091	888	...	707	1,025	611	2,508	146	102	1,759	11,783
Natal	370	5,202	1,281	197	...	80	3,351	1,713	346	20	21	151	12,732
Zanzibar, Brit. E. Africa, Mauritius & Aden	45	116	63	108	...	132	215	12	17	...	...	148	856
Azores, Madeira and Portuguese Africa ...	93	264	113	184	...	93	117	235	...	...	...	828	1,927
French African Colonies and Madagascar...	...	...	...	...	...	...	400	71	925	14	...	...	1,410
China and Siam	618	490	722	60	...	254	1,021	680	117	91	32	...	4,085
Japan and Korea	...	...	329	17	...	658	...	2,941	318	54	...	42	4,359
India	2,506	4,735	4,207	1,807	204	1,008	9,545	3,146	4,097	101	829	15	32,200
Ceylon	112	332	90	26	...	26	159	31	92	...	105	615	1,588
Straits Settlements, Fed. Malay States and Sarawak	196	30	410	223	...	144	1,961	5,142	...	...	187	124	8,417
Hong Kong	118	2,192	412	17	...	...	456	382	...	94	62	16	3,749
West Australia	84	696	244	1,156	...	750	243	...	...	88	50	...	3,311
South Australia	102	899	175	27	...	20	758	40	11	11	1,194	33	3,270
Victoria	1,049	13,971	7,802	1,394	105	766	36,004	20	650	232	8,542	...	70,535
New South Wales	465	6,313	2,894	2,171	31	1,184	12,246	4,777	1,616	24	4,174	119	36,014
Queensland	136	22	473	523	...	282	271	19	956	...	3,609	178	6,469
Tasmania	15	...	...	82	...	...	155	...	...	...	337	...	589
New Zealand and Fiji Islands	387	1,077	1,078	929	...	526	2,132	287	1,423	...	1,666	213	9,718
Total, £	19,985	71,608	28,162	14,007	1,000	12,662	97,405	43,177	20,588	1,447	49,803	57,925	417,769

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	756	21	235	470	240	4,571	18	460	1,198	2,052	10,021
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	...	264	11,944	349	...	446	...	143	...	...	13,146
France	59	1,936	505	48	1,165	2,089	542	...	3,909	4,912	159	15,324
Switzerland	4,178	198	86	...	61	1,171	463	...	...	1,160	...	7,317
Italy	...	1,185	...	...	...	...	2,184	...	...	121	...	3,490
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,300	322	2,468	3,129	4,408	272	8,095	122,549	2,294	8,960	4,706	165,503
Total, £	12,537	4,397	3,344	15,356	6,453	3,772	16,301	122,567	6,806	16,351	6,917	214,801

Additional imports.—Spain, electrical goods, £1,510; arc lamps, £429; carbons, £1,808. Portugal, batteries, £6. Canada, wires, £2,349; fittings, £1,020; arc lamps, £267; electrical machinery, £998; batteries, £46; carbons, £466; telegraph and telephone apparatus, £101.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	1,691	83	...	1,272	34	363	4,155	...	582	573	2,025	10,778

TOTAL EXPORTS: £417,769 TOTAL RE-EXPORTS: £10,778 TOTAL IMPORTS: £223,801

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third column contains many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

THE WEAVERHAM AND DISTRICT ELECTRICITY SUPPLY.

The scattered and thinly populated rural district in Mid-Cheshire served by the Weaverham and District Electricity Supply Co. is a feature of particular interest in connection with this undertaking. As far back as the year 1874 the idea was conceived to form a local company to supply the Weaverham district with gas, and again in 1894 a movement was on foot to establish an electric supply company, but both these proposals were set aside owing to the heavy capital expenditure that would have been necessitated for mains.

The present company was formed five years ago chiefly for supplying the districts of Weaverham, Acton and Acton Bridge, and the current was switched on for the first time in February, 1912, for 20 consumers, representing 600 30-watt lamps. At the end of the same year the consumers had been increased more than three-fold and the output multiplied by seven.

Several of the surrounding districts were constantly appealing to the company to extend their supply into their areas, and the directors, in view of the fact that the initial scheme had been a success, finally decided to extend the system and applied for statutory powers as regards Milton

Low-tension Overhead Line, with B. of T. Guards.

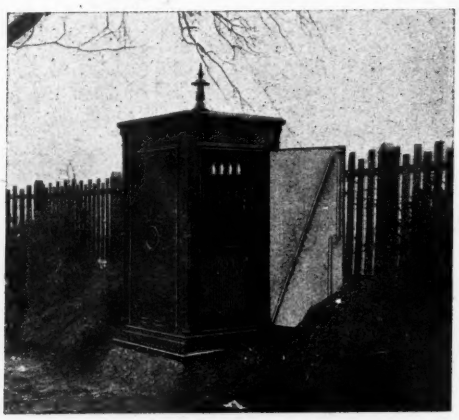
Gorstage, Cuddington, Sandiway, Oakmere and White Gate. The supply was first given over this new area on December 22nd, 1913, and some 30 consumers were connected to the mains.

At the end of last year, 180 consumers were connected to the mains, representing 8,500 30-watt lamps.

The scattered nature of the area served, which will be seen by reference to the plan which we reproduce, involved special consideration in view of the difficulty of keeping down the capital outlay on mains, and at the same time meeting the requirements prescribed by the Board of Trade as to the variation of pressure.

The original supply was on the three-wire direct-current system at 460/230 volts, consisting of some 5¾ miles of feeders and distributors, run overhead with three exceptions where for local reasons the roads were crossed with lengths of underground cable. The direct current area of the supply is at present served from the generating station by a ·1, ·06, ·1 sq. in. feeder terminating at a pole type distribution box adjoining the Gate Inn, Weaverham, at which point it passes through double-pole switches and fuses, and distributors are taken off for Weaverham, Acton and Milton townships. A second feeder is run from the generating station to supply the Weaverham Refining Co.'s works at Acton Bridge. Provision is also made for a third feeder to meet the foregoing network at Acton at a point called Wall Hill, 3¾ miles from the station.

The Sandiway and Cuddington extension consists of nearly four miles of 7/16's S.W.G. concentric paper-insulated lead-covered and armoured 3,000-volt main, laid



Transformer Kiosk at Sandiway.

direct in the ground from the generating station to a kiosk situated at the crossroads at Sandiway. On this route several large houses have taken current, reducing the voltage by means of transformers to their own particular needs.

The kiosk consists of a substantial ornamental cast-iron pillar mounted on a concrete base, with the high-tension and low-tension apparatus kept quite separate. To meet the present demands, and as duplicates there are two 15-K.V.A. oil-cooled transformers stepping down from 3,000 volts to 230 volts, and two high-tension main oil switches. Between the high-tension cables are bifurcating boxes with links, by means of which either or both transformers can be connected up. The door on the high-tension side is interlocked with the main switch, so that it cannot be opened until the switch is in the "off" position, making the kiosk dead. The switch can also be worked by means of a long detachable handle through a hole in the kiosk door closed by a shutter when not in use.

A second high-tension oil switch is fixed in the H.T. section for controlling a feeder which is at present tapped to supply two pole type transformers serving three large houses whose grounds are passed, but this feeder will eventually be extended into the low-tension distributor by

Interior of Generating Station at Weaverham.

means of step-down transformers at different points, in order to boost the voltage when the load increases and makes this necessary.

The low-tension section of the kiosk is provided with its

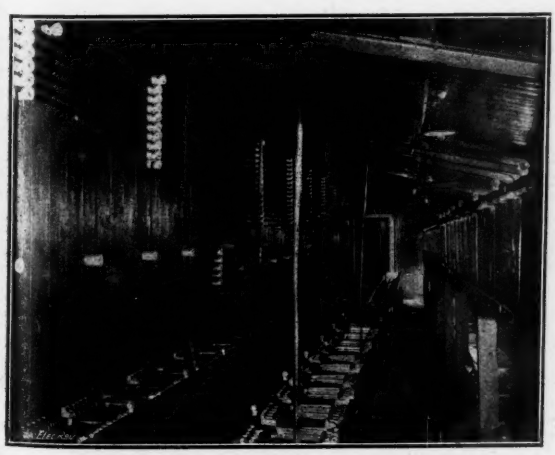
own door, and contains switches with porcelain handle fuses controlling the outgoing distributors, the ends of which are sealed in bifurcating boxes.

Owing to the position of the kiosk it was considered advisable to cross the roads underground, and run some

WEAVERHAM AND DISTRICT ELECTRICITY SUPPLY AREA.

distance to terminal poles, which are provided with lightning arresters, and up which the armoured cables are taken to pole type bifurcating boxes, from which overhead bare copper conductors continue.

The low-tension single-phase 230-volt bare copper distributors are carried on insulators mounted on swan-neck brackets, and a cross-arm with two insulators is fixed on



BATTERY ROOM, WEAVERHAM GENERATING STATION.

each pole above the line insulators, with bare copper wires taken over each insulator and connected to the lower conductor by means of brass tee connectors, to form a "V" each side of the pole, the lower conductor being earthed at the generating station. By this means the upper conductor, should it break, cannot fail to come into contact with the lower earthed conductor, as required by the Board of Trade.

The site selected for the generating station adjoins the River Weaver, and was presented to the company by Lord Barrymore, who owns considerable property in the district; plenty of water is always available, and fuel can be brought by boat as desired.

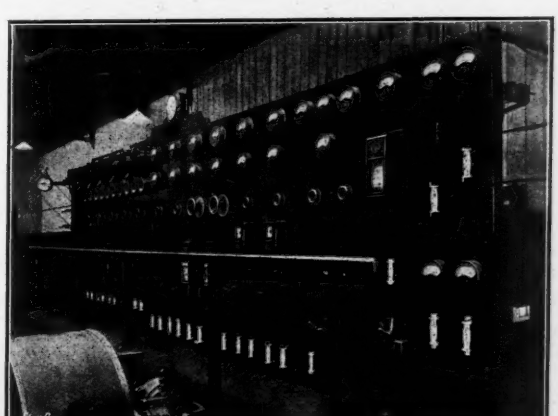
The plant in the original scheme consisted of two 18-KW. D.C. 460/500-volt generators, driven by two horizontal British Westinghouse gas engines fed from a Dowson and Mayson suction-gas plant. This plant is of such capacity, and the pipework so arranged that each producer is capable of serving either engine, or, if necessary, both engines can be run on either producer.

Particular care was given to the switchboard; all the machines are protected by double-pole enclosed fuses and automatic switches. On the left-hand side of the switchboard the conductor is arranged for the positive side of the system and the right-hand side for the negative.

The switchgear is fool-proof; in the case of the booster panels the switch is interlocking so that it is impossible for the booster armatures to be short-circuited whilst the fields are excited.

The battery panels are provided with instruments recording charge and discharge, and wattmeters recording units put in and taken out of the battery, the charge side of the meters reading slow and enabling the staff to put back the additional amount of energy required, based on the efficiency guaranteed by the makers.

The new plant installed consists of a 65-KW. 460/500-volt direct-coupled Johnson & Phillips generator, driven by a vertical four-cylinder Hindley engine taking gas from a Salmon & Whitfield gas plant. The latter is designed to burn low-grade anthracite, and is capable of dealing with all three engines. An electrically-driven fan is provided to facilitate starting, and also the engines are started up by the



MAIN SWITCHBOARD, WEAVERHAM GENERATING STATION.

"Leigh Osborn" patent starting gear, the combined arrangement enabling either engine or gas plant to be started up under five minutes.

Two 16-KW. Johnson & Phillips motor alternators link up the A.C. and D.C. systems. The D.C. machines are 460/500-volt, compounded when running as generators to give a flat voltage curve, and owing to cyclic variations experienced in a gas-driven station, as motors to give a constant speed. The A.C. machines are single-phase for 300 volts 50 periods, the fields being excited at 460 volts from the main switchboard.

One 14-KW. three-machine booster operates with the storage batteries, or, if desired, in series with the three-wire feeders.

The low-tension switchboard was extended by the addition of a 65-KW. generator panel; two D.C. motor and two A.C. generator panels for the motor alternator; a transformer and synchronising panel for the primary sides of two 15-K.V.A. step-up single-phase oil-immersed transformers,

arranged through D.P. switches and fuses so that either or both can be placed in work. The transformers step up from 300 to 3,000 volts, and from the high-tension sides leads are taken to a high-tension switchboard consisting of two steel cubicles built upon angle-iron framework, which contain two sets of isolating switches, two automatic oil switches, and two high-tension voltmeters.

This board puts either one or both of the transformers into the H.T. line.

All the cables are drawn through earthenware pipes, the H.T. cable terminating inside the cubicles; provision has been made at either end of the H.T. board for another feeder and an A.C. generator panel.

Both the H. and L.T. switchboards and cables were also made by Messrs. Johnson & Phillips.

The battery room contains two 500 ampere-hour batteries by the D.P. and Premier Battery Companies, and provision has been made in the containing boxes for the addition of more plates to increase the capacity to 700 ampere-hours. All the leads are bare copper rods supported on porcelain insulators.

The company's charges for energy are on a very reasonable basis, being 6d. per unit for lighting; 1½d. for heating and cooking; and 2d. per unit for power up to 1,000 units per quarter, all in excess being charged at 1d. per unit. As an alternative, the consumer can be charged £4 per K.V.A. of maximum demand, plus ¾d. per unit.

To deal with smaller classes of consumers, the company supplies at a fixed charge of 3s. 3d. per quarter per 30-watt lamp, or 400-watt iron, subject to the latter being used during non-lighting hours. Financially the company has been very successful; at the end of 1912, after only nine months' working, a dividend of 5 per cent. was paid, after allowing 2 per cent. depreciation and wiping 20 per cent. of the preliminary expenses off. At the end of 1913 the same dividend was paid and depreciation allowed.

The contractors for the scheme were Messrs. Johnson and Phillips, Ltd., who carried out the work to the specification of Mr. A. J. Leigh, the company's consulting engineer, the resident engineer being Mr. F. Foster.

AN INVESTIGATION OF DIELECTRIC LOSSES WITH THE CATHODE-RAY TUBE.*

By JOHN P. MINTON.

(*Concluded from page* 93)

The dielectric loss, power factor, and current have been determined for a number of different insulating materials and have been plotted against the applied voltage, the temperature, and per cent. absorbed moisture in the case of paper.

All the tests embodied in this paper have been made at 60 cycles with a generator which produces very nearly a sine wave. The tests were made in good transformer oil to avoid corona, and the brass test terminals were either 20 cm. or 25.4 cm. in diameter and 0.5 cm. thick. They were square-edged and arranged so that they could be clamped into position after good contact was obtained.

A large number of tests have been made on various kinds of varnished cloths. The different test samples were about 30 cm. square, and were built up of separate sheets of the same size to the required thickness. In figs. 7 to 10 are illustrated some of the results. For sample No. 1, it is seen that the losses at 138 deg. Cent. are forty-five times as great as they are at 25 deg. Cent., and for sample No. 2 the ratio is twenty-five to one. All the curves are consistent in showing that No. 1, No. 3, and No. 2 represent the order in which the samples should be placed, as far as their insulating value is concerned.

It will be interesting to compare these results on varnished cloths with those on some others. In one instance, with another varnished cloth at about 200 volts per mil and 100 deg. Cent. the watts per cu. cm. were about 4.0, the per cent. power factor 98, and the milliamperes per sq. cm. about 0.050. Comparing these values with those given in figs. 7 to 10, one will note the following points: watts per cu. cm. at 200 volts per mil and 100 deg. Cent. are about twenty-three times as great for the above cloth as they are for sample No. 1; the current value is about five times as great and the power factor about four and a half times as great for the former cloth as for the latter. On the other hand, another sample of varnished cloth has yielded a power factor at 100 deg. Cent. of about 13.5 per cent. compared with about 20 per cent. as shown in fig. 9. These numbers show in a striking manner the difference likely to be found in various kinds of varnished cloths, and they also show that tests of dielectric losses yield most valuable results. When a loss of 4.0 watts per cu. cm. is observed in a piece of insulation whose volume is about 250 cu. cm., it means that about a kilowatt is producing heat in it. Under such severe conditions a piece of insulation will always be punctured within a few minutes.

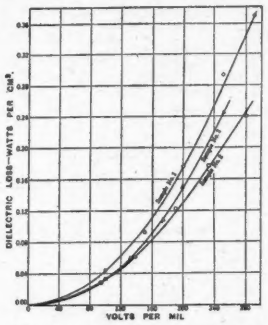


FIG. 7.—Dielectric Loss and Volts per mil at 100° C.

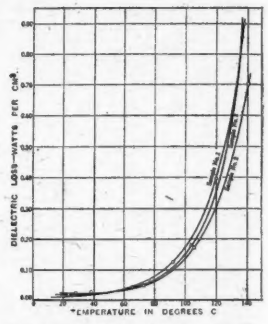
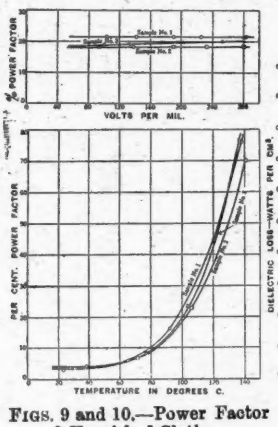


FIG. 8.—Dielectric Loss and Temperature at 200 v. per mil.

TWELVE-MIL BLACK VARNISHED CLOTHS; TOTAL THICKNESS: 1, 0·1214 in.; 2, 0·1245 in.; 3, 0·1093 in.

Samples of pressboard were cut, 30 cm. square, from regular 3/32-in. stock, and after drying were impregnated with good transformer oil. Each of the test pieces consisted of one sheet of oil-treated pressboard of the dimensions given above. Figs. 11 to 13 show a set of curves taken on pressboard sample No. 1.



FIGS. 9 and 10.—Power Factor of Varnished Cloths.

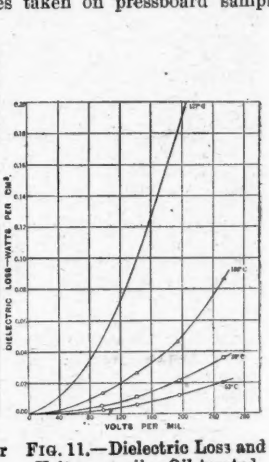


FIG. 11.—Dielectric Loss and Volts per mil; Oil-treated Pressboard 0·193 in. thick.

Results on two other samples of oil-treated pressboard, of the same kind as sample No. 1, show that a peculiar phenomenon occurs as the applied voltage is increased. One is surprised to observe large variations in the losses, power factors, and current values for the same insulations under the same voltage and temperature conditions. The explanation of these variations is found in the quantity of absorbed

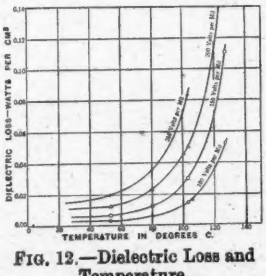


FIG. 12.—Dielectric Loss and Temperature.

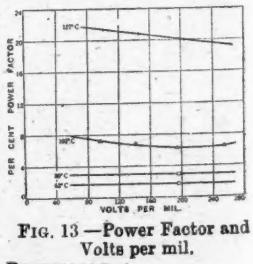


FIG. 13.—Power Factor and Volts per mil.

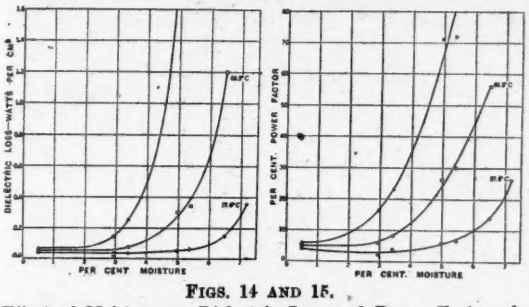
OIL-TREATED PRESSBOARD.

moisture the samples contained. In order to determine how the losses, power factors, and current for oil-treated pressboard are affected by the quantity of absorbed moisture, a number of samples of the same kind of pressboard as tested above was taken.

In figs. 14 and 15 will be found results taken at 200 volts per mil and at three different temperatures on several sheets of pressboard containing different percentages of moisture, which show the enormous influence absorbed moisture has on the losses and power factors for porous insulation capable of absorbing moisture.

* Abstract of paper read before the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, July 2nd, 1915.

The results are expressed in the form of empirical equations connecting the various quantities. The equations reveal the fact that the nature of the increased conductivity is the same for both temperature and moisture. This lends strength to the belief that moisture may be responsible for a large part of the phenomena observed. This is also further strengthened by the fact that the currents, power factors, and losses, increase many fold in the neighbourhood of 100 deg. Cent. and especially above this temperature. This temperature is a critical point for water at atmospheric pressure, but it would



FIGS. 14 AND 15.
Effect of Moisture on Dielectric Loss and Power Factor of Oil-treated Pressboard.

require over 100 deg. Cent. to boil water in extremely small capillary tubes such as exist in porous insulation. If the moisture is entrapped in an insulation that is only slightly porous, then it could not be eliminated by evaporation so easily. Consequently, when the temperature of the insulation is, say, 125 deg. Cent. the moisture may show decided increases in conductivity that do not show up below 100 deg. Cent. Since most of the losses are due to the absorbed moisture it is reasonable to believe that they are to a great extent in the moisture itself rather than in the insulation. This means that the temperature-rise occurs in the former before it does in the latter. Not more than 12 cu. cm. of moisture existed in any of the test samples considered in this paper, and for this reason the losses could apparently produce marked changes in the insulation. As a matter of fact, probably little change took place in the material itself, and almost the whole change probably was due to the increased conductivity of the moisture on account of the heating effects within it. It is advisable, therefore, to look carefully into the nature of the foreign material an insulation contains, whether this material be moisture or other harmful substances. The equations show that the weakening effects increase as the 5th or 6th power of the temperature and moisture. So that, if the moisture is present to only a few per cent., these effects become excessive and the increase of temperature magnifies them still more. As a whole, the results point to a conductivity of an electrolytic nature.

Both the current and voltage can be measured to within one or two per cent., but the largest error is introduced by the measurement of the minor axes of the ellipses on the photographic plates. For low power factors, as shown in the first illustration in fig. 6, each point for dielectric loss may be in error by 5.5 per cent. One, two, and five per cent. are used respectively for the errors due to voltage, current, and power factor measurements. When points for a curve are taken it is probably true that a point taken off an average curve will not be in error by more than about 2.5 per cent. Certainly, with the larger power factors this precision can be obtained with the cyclograph. An accuracy equivalent to this is quite satisfactory for the kind of work to which this apparatus is adapted.

The following conclusions are arrived at as a result of this investigation on dielectric losses:—

1. The successful application of the cyclograph in determining dielectric losses in insulations is amply demonstrated by the results given in this paper.

2. For good insulation the current should vary directly as the applied voltage. If the current increases more rapidly than this, it will show weakening properties.

3. The dielectric losses vary over wide limits depending on the condition of the tests and the nature of the insulations. The losses show clearly the electrical value of an insulation.

4. The results given in the paper show that the power factor of insulation may vary from about 2 to 99 per cent. The nature of the insulation and the condition of the tests determine its value.

5. It is shown that the watts do not vary as the square of the voltage, but may vary from the 1.32 to the 2.52 power of the voltage.

6. The weakening effects in insulation, as shown by the dielectric losses, power factors, and currents, may increase as rapidly as the 5th or 6th power of the temperature.

7. The weakening effects in pressboard, and very likely other water-absorbent insulations, may also increase as rapidly as the 5th or 6th power of the per cent. absorbed moisture. When the free moisture is above 3 per cent. the weakening effects due to its presence are quite pronounced.

8. Empirical equations are derived that will express the dielectric losses, currents, and power factors, as functions of the voltage, temperature, and absorbed moisture.

NEW ZEALAND'S WATER-POWER.

IN a recent issue of the *Engineering Magazine*, Mr. W. WILSON deals in an interesting manner with the various hydro-electric projects in the Dominion.

Both islands are mountainous in character and contain numerous lakes, cataracts, and waterfalls, and it has been estimated that at least 4,000,000 H.P. awaits development.

The Government controls the water powers, but, while developing certain large schemes itself, permits private concerns also to utilise water powers subject to an annual payment for the privilege.

About thirteen years ago a private company applied for rights to use the Waipori Falls, some 30 miles from the City of Dunedin. This request was granted without any payment, and not long afterwards the City Corporation purchased from the company the water-rights, which had been acquired for nothing. As a result, the Government decided in future to retain and develop all water powers, and announced, after some delay, their intention of expending £2,000,000 upon eight schemes distributed through the Dominion, at the following places:—

	H.P.	Cost.
1. Wairua Falls, North Auckland ...	3,000	£100,000
2. River Kaituna, South Auckland ...	10,000	320,000
3. Makuri, North Wellington	6,000	200,000
4. River Hutt, South Wellington ...	10,000	300,000
5. Lake Coleridge, Canterbury	10,000	270,000
6. Kumara, Westland	3,000	75,000
7. Teviot, Otago	10,000	300,000
8. Lake Hauroto, Southland	10,000	350,000

It was proposed to make an immediate start with locations Nos. 1, 4, and 5 at once, but eventually it was decided to complete No. 5 as soon as possible, and to use the experience so gained in carrying out the others. At the end of nearly four years, the plant mentioned is now in operation, but in the meantime the Government, which had held office continuously for 21 years, was replaced by one whose announced intention was to afford much greater facilities for the use of water-power. At once, a private company purchased, for £150 per annum, the rights to the Wairua Falls, No. 1, and their station is fast approaching completion. Other enterprise has taken place on smaller schemes, and is foreshadowed on a larger scale in the near future, though the rapid improvement in the lignite gas-producer has assisted the institution of small local power-houses at the expense of the hydraulic central station.

Dealing with the individual plants, that at Lake Coleridge was selected by the Government as their initial enterprise partly because of the demand for electricity by the citizens of Christchurch, who had been vainly endeavouring for years to secure water-rights for themselves, and partly because of the outstanding advantages of the scheme itself.

Christchurch is 70 miles distant, and three-phase transmission was decided on, at 66,000 volts—ten times the dynamo pressure. Entirely duplicate lines have been constructed, pursuing different routes. Aluminium cables carry the current, supported on porcelain pin-type insulators attached to ironbark poles at six-chain intervals.

The power-house was designed to contain six 1,500-H.P. Francis turbines, of which three by Escher-Wyss are already working, in conjunction with Bruce Peebles alternators. It is now probable, however, that the new units will be double the intended capacity. Six single-phase General Electric (U.S.A.) water-cooled transformers are used at each end of the line, and protection from lightning is afforded by aluminium electrolytic arresters made by the same firm. All are housed in a flat-roofed ferro-concrete power station, the construction of which cost 8½d. per cubic foot.

The current from this installation is to operate the first electric railway in New Zealand, that from Christchurch to the coast, which passes through a tunnel nearly two miles in length.

The Wairua Falls scheme is situated on a lowland river with no natural storage. It is being undertaken by the Dominion Portland Cement Co., whose new mill is under construction on the shores of Whangarei Harbour, sixteen miles distant; but electricity is also to be provided for the town of Whangarei, five miles further on. The Falls themselves are 48 ft. high, but they are followed by a series of cataracts which more than treble the head. A low dam 8½ ft. in height is being constructed across the river immediately above the Falls, which will impound sufficient water to keep the plant working for three weeks without any assistance from the river.

From the dam a race, 1½ miles long, will secure a head of 140 ft., and two Boving turbines are being installed in a ferro-concrete power-house to give 1,350 H.P. each. It is intended to duplicate this plant in the near future. The General Electric Co. (U.S.A.) have furnished practically all the electrical machinery. As in the previous scheme, aluminium cables are employed. The delivery of current was to begin in the middle of 1915, and the cost of the work is estimated at £50,000.

At the power plant of the Waihi Gold Mining Company at the Hora Hora Rapids on the Waikato River,

by cutting a straight canal, 100 ft. wide at the bottom, to short-circuit the rapids, and projecting an inexpensive crib-work dam into the river, a remarkably simple scheme for generating 9,000 KW. has been brought about. Six quadruple sets of Boving turbines drowned in forebays external to the generating station, drive the Siemens three-phase alternators within.

A distance of about 50 miles separates Hora Hora from Waihi, and the transmission voltage is 50,000 stepped up from 5,000 by single-phase transformers in a separate sub-station. A single transmission line only has been erected on latticed-steel towers with copper conductors. Current is provided to any towns in the vicinity that desire it. In this case, the water-rights cost the company £1,200 per annum.

Other power production is probable before many years upon the Waikato. At Hora Hora, the capacity of the present plant can be increased by at least 60 per cent. Nearer the lake are the Huka Falls capable of giving 38,000 H.P., and the Arateatea Rapids with a capacity of near 60,000 H.P.

Scheme No. 2 of the Government list possesses advantages of constancy equal to those of the Coleridge and Hora Hora plants; the Kaituna River will provide about 40,000 H.P. for development. This project is marked down for the supply of Auckland, but the transmission distance of 150 miles is delaying its achievement. Meanwhile, Auckland is equipped with a growing steam station, and other towns are also acquiring their own installations. At present there is in the Kaituna Gorge a small 250-KW. plant which makes use of a short cataract known as the Okere Falls. The system is three-phase, at 6,000 volts and 50 cycles, which frequency is the standard in New Zealand. A wooden pole line runs to Rotorua, eleven miles away.

The Waipori Falls station is interesting as being the first large hydro-electric enterprise in the Dominion, and an example of the mountain cataract type of scheme. The power house contains six 1,000-KW. units, each consisting of a General Electric (U.S.A.) generator driven by two Pelton wheels with Lombard governors and deflecting nozzles.

About 29 miles separate the Falls from the sub-station just outside Dunedin, and three-phase current is generated at 2,400 volts, and transformed to 34,700 volts for transmission. Dry seasons have caused constrictions in the output, and lately a Diesel stand-by station has been erected, which has largely corrected these faults. Storage, too, has been effected at three places above the Falls, with good results.

A small installation utilising Pelton wheels operates the pumping and other machinery of the Ross Goldfields, in Westland, where the chief requirement was the unwatering of abandoned workings. There was available an electric supply of 700 KW. obtained from Lake Kanieri, 23 miles away. This body of water covers twelve square miles, almost equal to that of Lake Coleridge but situated in a region where the annual rainfall is 120 in., about three times that at the latter place.

The generators give three-phase current at 2,300 volts, and single-phase transformers raise the voltage to 24,000 for transmission. In addition to the mine load it is intended to supply the towns of Ross and Hokitika, the capital of Westland, and the surrounding districts from this plant.

Railway electrification in the partially completed Otira Tunnel and its approaches in the mountain range separating Canterbury from Westland will make a demand for energy that is already under the consideration of the Public Works Department. While it is quite feasible to bring current from Lake Coleridge, roughly fifty miles distant, there are many local falls that may easily serve the purpose. Two of these are at present providing power for drilling the big tunnel on opposite sides of the Pass. Each contains two 290-KW. sets working at a head of 700 ft. Both plants suffer from occasional shortage, chiefly in winter, when the sources partially freeze. A steam plant of about 150 KW. is employed at the western end, where most work is done, to assist the water-wheels during times of scarcity. At Te Aroha, in the North Island, there is a municipal power station where a reservoir 800 ft. above the Pelton wheels equalises the supply to some extent.

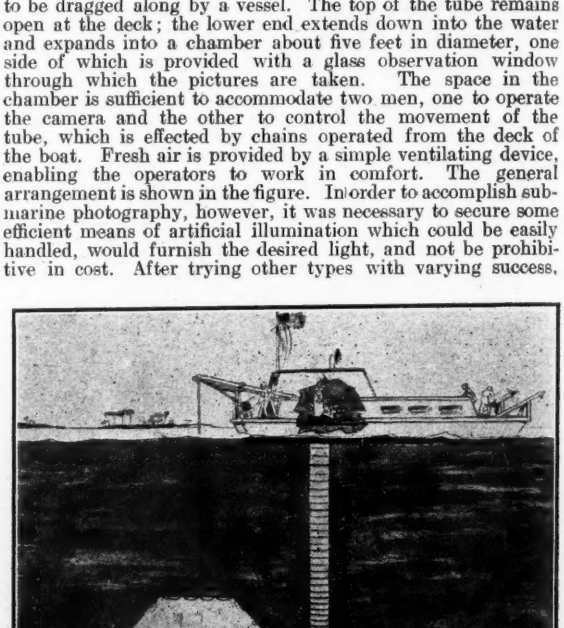
In addition to public schemes there are a number of private ones which have for their object the supply of single enterprises. New Zealand farmers are recognising more and more the great advantages of electricity not only for lighting, but also for shearing, milking, pumping, chaff-cutting, and the host of operations on a farm performed nowadays by machinery. Such plants, driven by hydro-electric current, are established at Kaiwarra, Glenmark, Hawarden, and Temuka, in Canterbury, and in other parts of the Dominion. So far, electric ploughing has not yet made its appearance, but this should not be long delayed.

Future opportunities for power development occur over almost the whole country. Practically every one of the numerous lakes is a potential power site of the most satisfactory order, and in spite of the war, activity in exploitation should continue. In one of the big schemes now under construction it was found that the electric machinery, though nominally British, was of German manufacture and could not be delivered. However, the deficiency was at once made good by an American firm and the opening will not be delayed by the change. For a long time New Zealand will be dependent upon imported machinery, the local manufacturers being at present restricted to the smaller apparatus, such as low-power transformers.

SUBMARINE PHOTOGRAPHY BY AID OF QUARTZ LAMPS.*

In these days of daring exploits of arms, where the engines of destruction that operate under water are the cause of so much comment, it is pleasing to turn to an equally remarkable but humane and constructive development of science. An achievement that seems destined to play an important part in marine affairs is that of submarine photography, or the taking under water of pictures, both stationary and moving. The actual taking of the photographs is not so difficult, the main requisite being to get beneath the water, to remain there in comfort, and be able to perform the work.

This work is made possible by an invention of Charles Williamson and his two sons, of Norfolk, Va., which consists of a collapsible accordion-like submarine tube of waterproof canvas and rubber, three feet in diameter, braced at regular intervals by iron rings. This construction permits the passage of a person down the tube, and its flexibility permits it to be dragged along by a vessel. The top of the tube remains open at the deck; the lower end extends down into the water and expands into a chamber about five feet in diameter, one side of which is provided with a glass observation window through which the pictures are taken. The space in the chamber is sufficient to accommodate two men, one to operate the camera and the other to control the movement of the tube, which is effected by chains operated from the deck of the boat. Fresh air is provided by a simple ventilating device, enabling the operators to work in comfort. The general arrangement is shown in the figure. In order to accomplish submarine photography, however, it was necessary to secure some efficient means of artificial illumination which could be easily handled, would furnish the desired light, and not be prohibitive in cost. After trying other types with varying success,



Arrangement for obtaining Submarine Photographs.

the Cooper Hewitt mercury-vapour quartz lamp was adopted. A battery of nine of these lamps, each of 2,400 C.P., was installed. The essential parts of the lamp are the quartz burner and the auxiliary. The former comprises the light-giving tube, its support and enamelled reflector, while the latter consists of the necessary tilting mechanism and coils for starting and maintaining the mercury arc.

In ordinary commercial use, the burner is suspended from the lower part of the auxiliary and enclosed in a glass globe, but for submarine work, the auxiliary is kept on board the boat, and the burner with its reflector holder is mounted in a casing that is placed in a frame and lowered into the water. The method of installation is shown above.

Highly instructive and interesting photographs and moving pictures have been taken through the water by the method described for a distance of 100 ft., thus marking an epoch in photography and surprising even the most ardent advocates of the scheme.

Electric Motor-car Running Costs.—With the object of ascertaining approximately the average cost of running electric motor-cars of the pleasure type, the Electric Vehicle Association of America recently sent out a circular letter to owners scattered over all parts of the United States. Over 100 replies were received, an analysis of which showed that where the vehicle is privately garaged, the average cost for battery charging energy is 23s. 10d. per month. The cost of washing, polishing, storage and battery charging in public garages varies from £3 to £8 per month; the average monthly distance travelled was found to be 300 miles, while the average battery life worked out at 2½ years. Tire costs average 11s. 7d. per month, the length of service secured from the tires extending from 15 to 48 months.

* *Electrical Review and Western Electrician.*

WAR ITEMS.

Exports to Allied Countries.—The Board of Trade desire to inform merchants, manufacturers, and shippers that applications for permission to export to allied countries goods of which the export is prohibited by proclamation will receive special consideration if it can be clearly shown that the goods are destined for the use, directly or indirectly, of the Allied Government concerned or its military or naval forces. Such applications must be made to the Secretary, Commission Internationale de Ravitaillement, India House, Kingsway, W.C. The Commission will not recognise as evidence of the official destination of the goods documents issued by provincial military or naval officers, other local authorities, or Government contractors in the country to which the goods are to be exported unless such documents are formally approved in writing by the competent Department of the Government concerned. British manufacturers, merchants, and shippers are, accordingly, warned that before entering into any contracts for the supply of goods stated to be for the use of the Government of an allied country they should first instruct their clients in that country either to furnish them with written evidence that the proposed contract has the approval of the Ministry of War, Ministry of Marine, or other Department concerned, or to have a notification of its approval transmitted by such Department to its representative on the Commission Internationale de Ravitaillement. Any firms accepting contracts without following the above procedure will do so at their own risk, and with full knowledge that permission to export the goods which they have contracted to supply may be refused. Applications for permission to export goods which are ordered by firms or individuals in an allied country for purely industrial purposes, and which are not destined for the use of an allied Government or its military or naval forces, should be made in the ordinary manner to the Secretary, War Trade Department, 4, Central Buildings, Westminster, S.W.

The Views of a German Electrical Manufacturer.—According to the "Morning Post," Dr. Wilhelm von Siemens, head of the great German electrical company that bears his name, has written, in the "Journal" of the Association of German Engineers, his views concerning the possibilities of submarine warfare. He declares that German engineering science must devote itself with supreme energy to the task indicated by the success achieved by the submarine boats in order to furnish the requisite counterpoise to the weight of the 12-inch guns and of their successors. He urges the necessity of losing no time in devoting work, pains, and money to the accomplishment of an aim that may at present be somewhat problematic, and in exhausting all possibilities and points of departure. It is an abnormality, he declares further, that a nation with a small number of its men under arms can occupy a commanding position in the world solely by the creation of a surpassing technical implement, whereas the real worth of a nation must depend on its size, on the nature and character of its men, of its culture, and of its capabilities. Dr. von Siemens concludes as follows:—"What has been achieved by means of our submarine boats is a tangible beginning which we shall bring to perfection. The power that we shall then obtain to exclude England from the trade routes leading to the centre of the English world-power we shall hold in our hands as a pledge, until the freedom of the seas and of the trade routes has been wrested from the English, not only for us but for the whole world."

The French Thomson-Houston Co.—The report for 1914 of the Compagnie Francaise Thomson-Houston, which was formerly in close relations with the Berlin A.E.G., details the arrangements which existed between the two companies, by way of reply to the attacks made upon the French company on account of the connection in question. Concerning the future development of the undertaking, the report remarks that co-operation between the French and the Germans appeared to be out of the question, but a solution of the complicated conditions would probably be simplified by the victory of the French arms. In the meantime, the French A.E.G. company had been dissolved. The gross profits of the French Thomson-Houston Co. amounts to £302,000, and the net profits, after meeting general expenses and interest on loans, to £181,000, as compared with £213,000 in 1913. The sum of £61,000 has been applied to depreciation, and the balance of £120,000 permits of the payment of a dividend of 5 per cent. on the ordinary share capital of £2,400,000.

The Berlin A.E.G.—According to a statement issued after a meeting of the board of directors on July 8th, the invoiced turnover from Berlin down to the end of April, plus the orders on hand—that is to say, for a period of ten months—amounted to the same figure as in the corresponding term in the preceding year, despite the absence of business with enemy countries. The credit held at the bankers at the end of the financial year, on June 30th, is reported to have totalled £4,150,000, exclusive of the £1,800,000 advanced to the A.E.G. High-Speed Railway Co., and the sum of £425,000 lent to the Berlin Electricity Works Co., whilst £500,000 has been invested in German and Austrian war loans. An order for a complete power station, with an initial equipment of 100,000 H.P., has been received from the Electro Works Co., which is to supply power in connection with a great scheme for the fixation of atmospheric nitrogen. The number of the company's employés called up for service has been 20,500, and the voluntary grants made by the company to their dependents have been about £250,000 down to the end of June.

Pro-German Agents Abroad.—The Board of Trade calls the attention of British firms who contemplate the appointment of new agents in foreign countries to the desirability of their satisfying themselves that the persons they propose to select are not unfriendly to Great Britain or her Allies. Where the individuals selected are not personally known to those with whom the appointment rests, the advice of His Majesty's Consular officers can always be secured in such cases by British subjects who apply to them.—"Financial Times."

Catalogues Wanted.—Lieutenant W. H. Marshall, R.E., M.I.E.E., M.I.Mech.E., would be glad to have the latest catalogues and price lists of cables, joint boxes, feeder pillars, dynamos, motors, switchgear, fittings for internal electric wiring, incandescent lamps, transformers, etc., sent to him at the Royal Engineer Office, Weymouth.

The War Loan.—In addition to the £17,000 already held by them in the original War Loan, the Armorduct Manufacturing Co., Ltd., have applied for a further £7,000 in the new Loan.

The St. Pancras B.C. has invested £10,000 of the electricity reserve fund in the new War Loan.

The County Co.'s Roll of Honour.—One of the most impressive rolls of honour that has yet reached us from electrical undertakings is that of the County of London Electric Supply Co., Ltd., and its associated companies. It gives the name, rank and regiment of 226 men "who have answered their country's call in defence of a 'scrap of paper.'" Three out of the number have been killed and four wounded.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

SOUTH AFRICA.—The following regulations have been laid down by the Government:—

Exportation of the following goods is prohibited except with the permission of the Minister of Defence: Mining cables; mines and parts thereof; searchlights; naval and military stores of every description; shipbuilding materials; signalling lamps; submarine and other signalling apparatus.

Exportation of the following goods is prohibited, except with the permission of Collectors of Customs, to destinations in the British Empire and countries of Allies and Neutrals: Asbestos; copper and zinc in ingots of approved brands (affecting re-exports only); india-rubber sheet, vulcanised; mica (including mica splittings) and micanite.

Exportation of the following goods is prohibited to all destinations other than the United Kingdom, British possessions and protectorates: Aluminium, aluminium alloys, etc.; copper unwrought and part wrought, all kinds; ferro-alloys; graphite; lead, pig, sheet, or pipe; tungsten, molybdenum, vanadium, nickel, selenium, cobalt, and manganese; rubber goods.

Exportation of the following goods is prohibited to all foreign ports in Europe, and on the Mediterranean and Black Sea, other than those of France, Russia (except Baltic ports), Belgium, Spain, and Portugal: Magnetic iron ore; copper ore, hematite iron ore, iron ore, hematite pig iron, iron pyrites; railway material, both fixed and rolling stock; materials for telegraphs, wireless telegraphs, and telephones; galvanised wire; steel wire.

NORWAY.—The Norwegian Government has prohibited the exportation of the following goods: Antimony, unwrought, crude, and scrap; graphite, unwrought or crude, except graphite produced in Norway and accompanied by a certificate of origin; graphite for use in foundries, including crucibles; molybdenum, unwrought or crude; scheelite, wolframite, and molybdenite, except that produced in Norway and accompanied by a certificate of origin; vanadium and tungsten, unwrought or crude.

FRANCE.—The Board of Trade are in receipt, through the Foreign Office, of copy of French Ministerial Decree, dated April 28th, which abrogates the provisions of the Decree of February 12th in virtue of which lead ore was allowed to be exported from France, without special authorisation, when consigned to the United Kingdom, the British Dominions, Colonies and Protectorates, Belgium, Japan, Montenegro, Russia, Serbia, and the United States of America.

H.M. Ambassador at Paris, in forwarding this Decree, states that he has been informed by the French Ministry for Foreign Affairs that applications for special permission to export consignments of lead ore to the United Kingdom will be favourably considered.

SPAIN.—The Spanish Government has prohibited the exportation of the following goods: Aluminium and alloys thereof, antimony and alloys thereof, bauxite or aluminium ore, tin and alloys thereof, zinc and alloys thereof in cakes, nickel and alloys thereof, rubber and mixtures thereof, wholly or partly manufactured; anhydrous or hydrated alumina,

chrome, molybdenum, manganese (metal), vanadium, ferro-chrome, ferro-molybdenum, ferro-nickel, ferro-tungsten, ferro-vanadium, and partly or wholly manufactured articles of copper or brass; tinplate.

ROUMANIA.—The Roumanian Government has prohibited the exportation of the following goods: Old iron; metal ores; tinplates and tins; graphite; mercury; cords and cables of any kind.

CANADA.—The following regulations regarding the prohibition of exportation of certain goods have been issued by the Canadian Government:—

Mica and micanite to all destinations other than the United Kingdom, British possessions and protectorates, France, Russia (except Baltic ports), Japan, United States (when for consumption in United States only or shipped to specified consignees in United Kingdom *via* United States, or exported *via* United States under licence or dispensation from Canada).

To all destinations abroad other than the United Kingdom, British possessions and protectorates: Carbons suitable for searchlights; certain chemicals; ferro-alloys; graphite, including foundry, plumbago. Metals and ores, the following, namely:—Alumina and salts of alumina; aluminium and alloys of aluminium; antimony and alloys of antimony; bauxite; chrome ore; cobalt; copper, unwrought and wrought; lead, ore, pig, sheet, or pipe (including solder containing lead); manganese and manganese ore; mercury; molybdenum and molybdenite; scheelite; selenium; tin and tin ore; tungsten; vanadium; wolframite; zinc and zinc ore, and sheets; mines and parts thereof; rubber; searchlights; signalling apparatus; telephone sets and parts thereof; galvanised wire and steel wire.

To all foreign ports in Europe and on the Mediterranean and Black Seas other than those of France, Russia (except Baltic ports, Belgium, Spain, and Portugal): Asbestos; rubber sheet, vulcanised; copper ore, iron ore, hematite pig-iron, iron pyrites, nickel and nickel ore; engine and boiler packings; railway material, both fixed and rolling stock; materials for telegraphs, wireless telegraphs, and telephones.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this Journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

9,783. SPARKING-PLUGS FOR INTERNAL-COMBUSTION ENGINES. Daimler-Motoren-Ges. July 5th. (Convention date, July 6th, 1914, Germany.) (Complete.)

9,792. STARTING ARRANGEMENT FOR INTERNAL-COMBUSTION ENGINES IN WHICH AN ELECTRIC STARTING MOTOR IS USED. Soc. Anon. pour l'Eclairage Electrique des Vehicules. July 5th. (Convention date, July 30th, 1914, France.) (Complete.)

9,797. APPARATUS FOR OPENING AND CLOSING ELECTRICAL CIRCUITS AT A CERTAIN TEMPERATURE. E. J. Sumner. July 6th.

9,806. SWITCHES FOR CONTROLLING LIFT OR OTHER MOTORS. J. A. Steven. July 6th. (Complete.)

9,808. APPARATUS FOR GRINDING THE PLUGS INTO THE SEATS OF STEAM AND LIKE COCKS. Smith Bros. & Co., Ltd., and J. M. Dempsey. July 6th.

9,809. SELF-REGULATING DYNAMO-ELECTRIC MACHINES. Boultbee Brooks and W. Holt. July 6th. (Complete.)

9,812. DEVICES FOR LOCALISING BODIES BY THE AID OF X-RAYS. F. F. Renwick. July 6th.

9,828. MANUFACTURE OF ELECTRIC HEATING ELEMENTS. H. J. Dowsing & D. Huntley. July 6th.

9,834. ELECTRIC MINE LAMP. J. W. Rigby. July 6th.

9,836. ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co., Ltd. (General Electric Co., United States). July 6th.

9,852. IMPULSE TRANSMITTERS FOR TELEPHONE SYSTEMS AND THE LIKE. Relay Automatic Telephone Co., Ltd. (L. C. Bygrave). July 6th.

9,875. ELECTRIC LIGHTING MEANS. R. S. Woods. July 7th.

9,899. ELECTRICITY TRANSFORMERS. J. Longman. July 7th.

9,903. ELECTRICAL CONNECTIONS PARTICULARLY APPLICABLE TO THE SPARKING PLUGS OF INTERNAL-COMBUSTION ENGINES. J. A. Kennedy-McGregor. July 7th.

9,912. RECEPTION AND TRANSMISSION OF SOUND OR COMPRESSIONAL WAVES. S. G. Brown. July 7th.

9,915. BRAKE FOR ELECTRICALLY-PROPELLED VEHICLES. Rt. Hon. H. L. Samuel, W. Slingo, H. C. Gunton, and C. H. Douglas. July 7th. (Divided application on 15,539/14, January 28th, 1915.) (Complete.)

9,921. ELECTRICAL TRANSFORMERS. G. Harlow. July 7th.

9,922. ROTARY MOTORS. E. E. Hauer. July 7th. (Complete.)

9,934. SMALL OR POCKET ELECTRIC FLASH LAMPS. F. O. Trautmann. July 8th

9,938. NIGHT GUN-SIGHTING ELECTRIC TORCH. D. Goodman. July 8th.

9,957. PREPARATION OF ELECTROLYTES FOR USE IN THE ELECTROLYTIC DEPOSITION OF METALS. P. Marino. July 8th. (Addition to 28,953/13.) (Complete.)

9,960. VAPOUR ELECTRIC DEVICES. British Thomson-Houston Co., Ltd. (General Electric Co., United States). July 8th.

9,964. ELECTRIC JOINT. G. H. Scholes. July 8th.

9,972. STORAGE BATTERY ELEMENT AND METHOD OF MAKING THE SAME. J. Redding. July 8th. (Convention date, July 10th, 1914, United States.) (Complete.)

9,981. ELECTRIC CLOCK. F. O. Read. July 8th.

9,982. APPARATUS FOR DETECTING, INDICATING, OR MEASURING VARIATIONS OR MOVEMENTS IN MAGNETIC FIELDS. G. J. Paulin. July 8th.

9,993. COMBINED LOCKING DEVICE AND SHADE SUPPORT FOR ELECTRIC INCANDESCENT LAMPS. W. C. Crockatt. July 9th.

10,006. TELEPHONE AND OTHER DIAPHRAGMS. B. A. Pilkington. July 9th.

10,026. ELECTRIC JUNCTION BOX. G. H. Scholes. July 9th.

10,050. IMPULSE-SENDERS FOR SUBSCRIBER APPARATUS IN AUTOMATIC EXCHANGE SYSTEMS. Aktieselskabet Elektrisk Bureau. July 9th. (Convention date, July 14th, 1914, Norway.) (Complete.)

10,054. TELEPHONE LOCKS. J. E. Lavalley. July 9th. (Complete.)

10,059. VIBRATING MAKE-AND-BREAK DEVICES FOR USE IN ELECTRIC SIGNALLING. A. C. Brown. July 10th.

10,067. CLOCKWORK TIME-SWITCHES AND THE LIKE. E. H. Horstmann and Horstmann Gear Co., Ltd. July 10th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

24,029. "Manufacture of incandescent electric lamps." C. GLADITZ. October 23rd.

24,450. "Arrangement for the automatic protection of air-cooled electrical machines against damage through ignition of the air filters." ALLGEMEINE ELEKTRICITATS GES. October 28th. (January 29th, 1913.)

1914.

3,020. "Magnetic speed indicators." W. BECKMANN. February 5th. (March 15th, 1913.)

3,021. "Eddy current speed indicators." W. BECKMANN. February 5th. (April 14th, 1913.)

6,866. "Electrical treatment of ores." F. W. HIGHFIELD. March 18th.

7,214. "Trolley or collector wheels for electricity." H. MCREYNOLDS. March 21st.

7,265. "Regenerative braking of electric motors." AKT. GES. BROWN, BOVERI ET CIE. March 23rd. (March 22nd, 1913.)

7,682. "Incandescent electric lamps." BRITISH THOMSON-HOUSTON CO. (Allgemeine Electricitäts Ges.). March 26th.

7,684. "Methods of synchronising rotary and cascade converters." SIEMENS-SCHUCKERTWERKE GES. March 26th. (April 16th, 1913.)

7,760. "Memorandum boards for use in connection with telephones and the manufacture thereof." J. F. SESSLER VON HERZINGER. March 27th.

7,761. "Method and apparatus for the internal irradiation of the human body by means of rays emanating from a Röntgen-tube or other source." E. POHL. March 27th. (March 29th, 1913.)

7,779. "Commutators for dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD., C. P. BRAMLEY, & T. A. WISDOM. March 27th.

7,868. "Apparatus for diminishing the air friction in electric machines having flywheels." SIEMENS-SCHUCKERTWERKE GES. March 28th. (March 29th, 1913.)

8,147. "Cooling device for the electrodes of vacuum tubes, particularly Röntgen tubes." R. GRISSON. March 31st. (October 14th, 1913.)

8,258. "Polyphase commutator electric machines." SIEMENS-SCHUCKERTWERKE GES. April 1st. (April 3rd, 1913.)

8,353. "Pocket electric lamps adapted to be used as target illuminating devices for pistols and the like." P. SCHMIDT & C. DOBSLAW. April 2nd. (April 28th, 1913.)

8,367. "Electrolytic apparatus." MASCHINENFABRIK SURTH GES. April 2nd. (September 3rd, 1913.)

8,385. "Rotary converters provided with boosters." E. ROSENBERG. April 2nd.

8,473. "Automatic signalling devices for indicating faults or other abnormal conditions of electric circuits." SIEMENS BROS. & CO., and W. H. GRINSTED. April 3rd.

12,361. "Selenium cells especially adapted for use in connection with telegraphy." J. S. WITHERS (K. C. COX). May 19th.

14,470. "Means for controlling the heating effect of electric heating apparatus." A. F. BERRY. June 16th.

14,669. "Electric candle lamps." C. DAMEY & G. BRADLEY. June 18th.

14,800. "Apparatus for and method of operating electric signs, devices, indications, and the like." L. MARTIN. June 19th.

14,817. "Electrical condensers." BRITISH INSULATED & HELSBY CABLES, LTD., E. A. BAYLES, and H. HIGHAM. June 20th.

14,891. "Receivers for use with electrical apparatus for transmitting and receiving signals." SIR A. T. DAWSON & G. T. BUCKHAM. June 20th.

14,984. "Electric railway systems." RT. HON. C. E. H. HOBHOUSE, W. SLINGO, H. C. GUNTON, & C. H. DOUGLAS June 23rd.

15,194. "Electric motor meters." BRITISH THOMSON-HOUSTON CO. (General Electric Co.). June 24th.

15,329. "Metal-filament electric lamps." SIEMENS BROS. & CO., and W. H. LE MARECHAL. June 26th.

15,489. "Electric lamps and their holders." F. JONES. June 27th.

15,585. "Dynamo-electric machinery." HON. SIR C. A. PARSONS. June 29th.

15,617. "Wire filaments for incandescent lamps, and other electric resistances." W. H. SABINE. June 29th.

15,749. "Electric fuses." A. F. DAUM. July 1st.

16,590. "Cooling arrangements for dynamo-electric machinery." SIEMENS BROS. DYNAMO WORKS, LTD., and E. O. KIEFFER. July 10th. (Cognate application, 18,396/14.)

16,680. "Radiators containing liquid and heated by fuel, steam, or electricity." H. FRANK. July 13th.

18,870. "Combined lampholder and contacts for electric portable lamps." G. PEARSON. August 20th.

19,054. "Receiver for wireless systems." A. J. ROBERTS. August 25th. (August 25th, 1913.)

20,552. "Magneti: separators." S. BRUCK. October 5th. (October 3rd, 1913. Additions to 11,898/11.)

21,435. "Electric incandescent lamps." BRITISH THOMSON-HOUSTON CO. (General Electric Co.). October 23rd.

21,955. "Inter-communication telephone systems." W. BLOGG & STERLING TELEPHONE & ELECTRIC CO., LTD. November 3rd.

22,487. "Electric measuring instruments for alternating currents." P. M. LINCOLN. November 13th. (November 29th, 1913.)

22,691. "Footsteps for telegraph and like poles, brackets for shelving, and other like brackets." BULLERS, LTD., & B. WOOD. November 18th.

23,791. "Electric ignition apparatus for internal-combustion engines." C. B. BURDON (Siemens & Halske Akt. Ges.). December 9th.

23,868. "Slot-keys or slot-closing devices for use in dynamo-electric machinery." C. B. BURDON (Siemens Schuckertwerke Ges.). December 10th.

1915.

1,453. "Mercury globule electrical contact maker for releasing mine winding signal indicators, actuating indicators of the stopping, starting, and reductions of speed of machinery and the like." G. SAINT. January 29th.